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ORIGINAL ARTICLES

SOME METHODS OF SOIL MANAGEMENT*

BY

D. V. BAL,

Agricultural Chemist to Government, Central Provinces, Nagpur

INTRODUCTION

THE term 'soil management' has been assigned a very wide meaning and it includes various aspects of crop growth in relation to the soil, *e.g.*, formation of soils, physical characteristics of soil, plant nutrients present in the soil in relation to the requirements of various crops, biological relationships existing between the soil and plant and many other aspects which find a place in a treatise on the subject of soil management. As it is not possible to deal exhaustively with the subject of soil management in an article like this, it is proposed to restrict attention only to those aspects which concern the production and conservation of plant food in the soil, regulation of soil moisture and soil amelioration. This article does not necessarily deal with new or novel methods of soil management, but it is hoped it will emphasise the urgent need of practising some of the important methods which have been evolved recently or have been known for some time, but are either not practised to the desired extent by the cultivators or have fallen into disuse for unknown reasons.

GENERAL REQUIREMENTS OF CROPS

Plants require for their growth substances like carbon dioxide, water, oxygen, and suitable compounds of nitrogen, phosphorus, potash, sulphur, calcium and magnesium. Of these carbon dioxide is obtained from the atmosphere and some, like calcium and sulphur, though taken in large quantities are ordinarily present in sufficient quantities in average arable soils. Special cases are however met with where the lime status of the soil is required to be adequately maintained by artificial methods. Nitrogen, potassium and phosphorus compounds which are also required by the plants in large quantities are however generally present in inadequate quantities in Indian soils and are therefore required to be supplied to the soils in order to obtain better crop yields.

In order to make the land yield the maximum outturn, it is not only necessary that the soil should contain the required elements in sufficient quantities, but it is also necessary that the physical condition of the soil should be such as to facilitate good root growth by regulating air and water-supply.

* This is the sixth of a series of popular articles for practical farmers on various agricultural subjects of general interest.

IMPORTANCE OF ORGANIC MATTER IN THE SOIL

The physical condition of the soil depends upon the presence of right proportions of various mechanical constituents like clay, silt and sand in the soil in relation to the climatic conditions, and in addition an adequate proportion of organic matter and lime. Indian soils, in general, are deficient in organic matter. This may partly be due to the rapid decomposition of organic matter under the conditions of high temperature prevailing in India, and partly to the fact that most of our soils have been under cultivation for centuries, without adequate return of organic matter to the soil in the form of cattle manure or crop residues.

An adequate amount of organic matter in the soil is absolutely essential in order to bring the soil into the required state of tilth and for the better utilisation by plants of the fertilising constituents that may be present in the soil or which may be added in the form of artificials. In view of the fact that organic matter performs a most important function in maintaining the right physical condition of the soil and of promoting many beneficial biological activities, we shall first consider some of the methods which help to increase this important constituent in the soil.

EASY METHODS OF INCREASING ORGANIC MATTER IN THE SOIL

One of the usual methods known to the cultivator and practised by him for many years is to apply farmyard manure to the soil. A very large quantity of the available cow-dung is however normally used as fuel by the cultivators and this practice is bound to continue till an alternative source of fuel becomes available. There are, however, various other methods by which organic matter can be added to the soil as described below :—

(1) Organic matter added to the soil can produce beneficial effects only when it does not differ widely in composition from natural soil organic matter or humus. This can be achieved by adopting methods which can convert various types of organic waste products of the farm into artificial farmyard manure, and incorporating the latter with the soil. Since the original work of Hutchinson and Richards was published in 1924, efforts in this direction were made by different agricultural investigators in India, and suitable methods have now been worked out for the preparation of artificial farmyard manure. Details of these methods suitable for any particular tract can be obtained from the departments of agriculture concerned. Various types of waste materials like dry leaves, stalks of cotton, pigeon pea, sann-hemp and *ambadi*, weeds from the fields and waste lands, old thatching material, inedible fodder and various kinds of stubble, are usually available in large quantities and if these materials are properly utilised the cultivators can enrich their fields in organic matter and thereby improve the condition of the soil, and thus obtain increased crop yields.

Trials conducted at Indore [Jackson *et al*, 1934] have shown that the permeability of black cotton soils is nearly doubled when dressed with compost.

Its application also increased productivity of black cotton soil and maintained a steady supply of nitrified nitrogen both on black soils and sandy soils.

(2) Material known as "gutterfly" which is available in large quantities from cotton spinning and weaving mills has been found to be very valuable as organic manure. Gutterfly consists of the residue obtained when cotton bales are opened and passed through the blower. It usually contains about 80 to 85 per cent of organic matter and about 1 per cent nitrogen. This can be applied to *rabi* land directly during summer, by spreading it on the land and leaving it to get thoroughly moistened by the rain, thereafter turning under as opportunity offers. The Nagpur Agricultural College Farm started using gutterfly as a manure many years ago, and experience has shown that, with adequate moisture, it is completely decomposed in about two to four weeks after burying in the soil. For the *kharif* crops the usual farm practice is to use either well-rotted gutterfly or else the material is spread and ploughed in just after the harvest of the preceding *kharif* crop, *i.e.*, between November and January. The winter rains usually suffice to bring about the rotting, but if no winter rain is received sowing of the subsequent crop is somewhat delayed. Addition of gutterfly has been found to improve remarkably the condition of the soil and the crop yields, and it is therefore recommended that cultivators in the vicinity of cotton mills should make use of this valuable material for the improvement of their fields.

(3) In addition to the above two sources of organic matter there is yet another important source, namely, green manuring. The value of green manure as a source of organic matter has been known to the cultivators of China and European countries for over five hundred years but it is only since the nineteenth century that general interest has been shown in this subject and today the practice of green manuring finds favour with many cultivators outside India and is very commonly adopted by them to enrich the soil in organic matter. Ordinarily, green manuring means turning under undecomposed plant material either grown *in situ* or brought from the adjoining fields. The former method can only be adopted in *rabi* lands, or in fruit orchards when the plants are small and the soil requires to be enriched with organic matter. In the case of *rabi* crops, from the experience gained in the Central Provinces, Allan [1915] has shown that at least twelve to sixteen inches of rain must be received after the inversion of the green crop so that there may be sufficient water to bring about the proper rotting of the organic matter and also to support the subsequent *rabi* crop. For *rabi* lands sann-hemp has been found to be a suitable green manuring crop as it is quick growing, adequately leafy and soft and hence susceptible of quick decomposition in the soil. It also possesses a very high nitrogen-fixing capacity and hence it is very helpful in recuperating soil nitrogen. Experience on the Nagpur Farm has shown that even when sann-hemp is grown as a fibre crop, the subsequent cotton crop gives a far better yield than that grown in a field previously cropped with either cotton or *juar*, owing to the effect of organic nitrogen

added to the soil as a result of sann-hemp leaves falling on the ground and the root residues left therein. In order to conserve the added organic matter and nitrogen in the soil a light cultivation with the *bakhar* is usually given after the sann crop is harvested so as to incorporate the organic matter with the soil.

In paddy tracts where transplantation is practised, the *rabi* land may be utilised for growing the green crop, which may be cut and added to the rice fields at the time of transplantation. Grasses and other vegetation growing on the *bunds* may also be utilised as above, thus securing a two-fold advantage of enriching the land with organic matter and of clean cultivation. The striking effect of green manure on paddy crop can be clearly seen from Plate I. In this connection, it must be mentioned that if the green manure is applied either one or preferably two weeks before the date of transplantation of the rice seedlings, the yield obtained is considerably higher than that obtained when the green manure is incorporated with the soil at the time of transplantation.

If perennial or annual quick-growing legumes like varieties of *Sesbania* and *Erythrina* are grown on the *bunds* of rice fields, borders of *kharif* and *rabi* fields, and on available waste areas, large quantities of useful green manure and fuel can be easily secured without any extra expenditure, and in addition the deep-rooted trees would thus help to extract nutrients from the subsoil and bring them up to the surface.

(4) Another important source of organic matter is human excreta or night soil which, if efficiently utilised as manure, would prove of immense value in enriching the soil. The importance of this material as a soil-fertilising substance has long been recognised, as is evident from the high prices offered for land situated near the village sites which gets highly fertilised and gives higher crop yields than those obtained from ordinary fields away from the village. Although the value of night soil is recognised its use as manure has been entirely neglected partly on account of the distasteful task of applying it to the land and partly due to caste prejudice and conservatism. By applying modern methods of sewage purification an odourless material can be manufactured, and wherever such material is available the cultivators should cast off their prejudices and come forward to utilise this valuable organic material. Even in rural areas where elaborate modern methods of sewage disposal are not practicable, simple and inexpensive methods like the ' earth-closet ' system or the ' movable latrine ' system can be easily adopted. In these days of severe competition, unless and until the natural manurial resources of our country are utilised to the fullest extent, we cannot expect to get crop yields of the same order as those obtained in Japan, America, and on the Continent. It is quite a common practice with many educated but non-agricultural persons of our country to compare the crop yields of India with those obtained in Japan or America and deplore the state of our country in this respect ; but the explanation for this is not very far to seek. While every one wishes that the crop yields, say of paddy, of our country should

SHOWING THE EFFECT OF GREEN MANURE ON PADDY

FIG. 1.—Unmanured

FIG. 2.—Green-manured with sann-hemp

be as high as those obtained in Japan, we want neither to exert ourselves even half as much as the Japanese cultivators do, nor do we want to make full use of the available natural resources of organic manure which the Japanese cultivator uses to the fullest possible extent without any prejudice whatsoever. In other words he follows his profession whole-heartedly and conscientiously. Comparative effect of cattle-dung and poudrette on various crops can be seen from Fig. 1, which has been reproduced here after some modification from the Central Provinces Agricultural Department Bulletin No. 16.

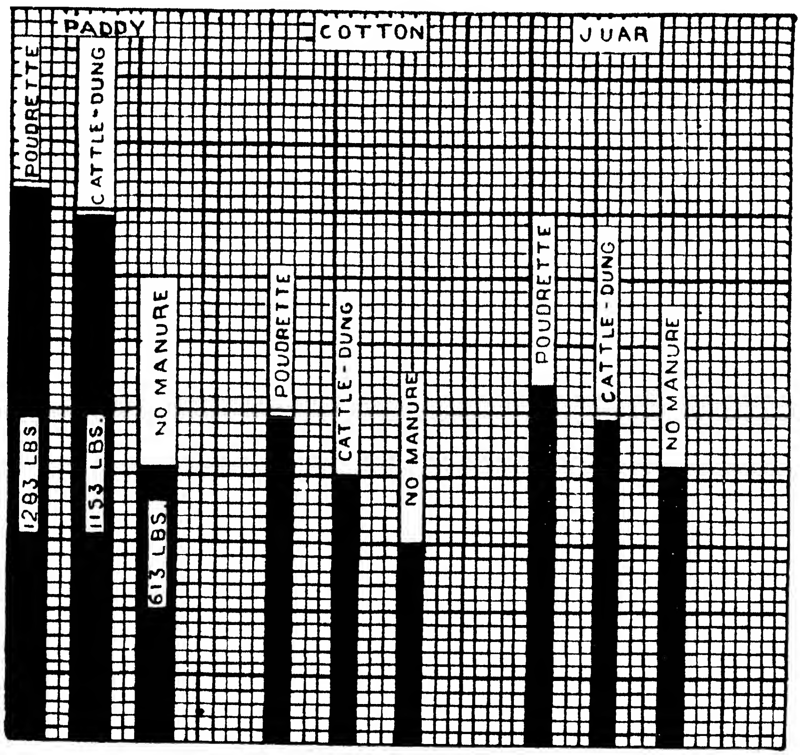

FIG 1.—Showing the effect of poudrette and cattle dung on the growth of various crops. Each square = 10 lbs. of produce.

In addition to the various factors discussed above, there is one more important method of conserving soil fertility, *i.e.*, the practice of proper rotation. Continuous cropping with the same crop year after year produces the following important effects, which tend to lower the yield of the crop :—

(1) Soil is cultivated to a uniform depth so as to suit the requirements of a particular crop, which may result in the formation of a hard layer at a particular depth in the soil which would interfere with the penetration of the plant roots.

(2) Certain weeds adapted to live among a particular crop get a chance to establish themselves and thus may seriously infest the field after a time.

(3) Certain diseases and pests find favourable conditions to establish themselves and infest the crop with increasing intensity year after year.

(4) Soil may get exhausted of certain plant food constituents partly because these are required in appreciable quantities by the crop, and partly because the root-system of a particular crop being of a fairly uniform type the roots penetrate into the soil only up to a certain depth.

In order therefore to maintain the yields of farm crops and also to maintain the soil fertility, growing different types of crops in rotation has been found to be successful in most parts of the world. Choice of crops required for this purpose will depend upon the climatic and economic conditions of a particular tract, but a wide range of crops is usually available, from which suitable crops can be selected. The importance of introducing a suitable leguminous crop in the rotation to be adopted cannot be overemphasised. In the cotton tract of the Central Provinces, *e.g.*, a three course rotation of 'cotton—*juar*—groundnut' has been found to be most suitable. In this type of rotation there is a three-fold provision of a money crop of cotton, a fodder and a grain crop of *juar*, and a soil-recuperating crop of groundnut.

Experience in the Central Provinces has also shown that wheat grown in rotation with legumes gives a better outturn than when it is grown without any rotation or in rotation with non-legumes, *vide* Fig. 2.

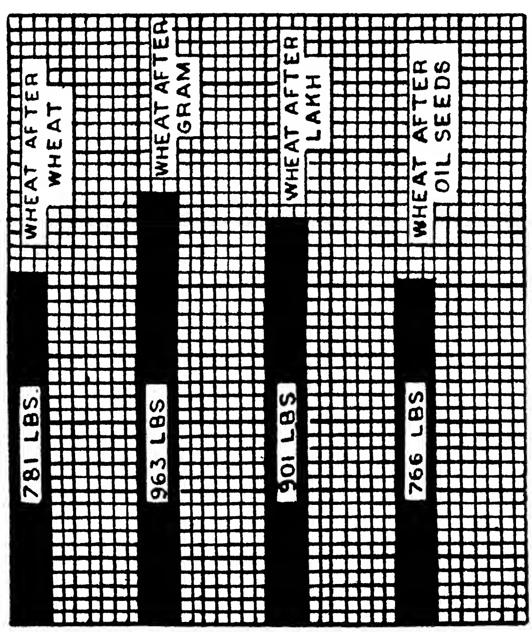

FIG. 2.—Showing the effect of rotations on wheat crop.
Each square=10 lbs. of wheat grain.

ARTIFICIAL FERTILISERS

Having dealt with the question of supply of organic matter to the soil and its conservation at some length, we shall briefly consider the question of supply of the three important nutrients, *viz.*, nitrogen, phosphorus and potash which have been referred to in the beginning. Out of these three, nitrogen appears to be pre-eminently the limiting constituent in the soil and applications of nitrogenous fertilisers, therefore, often give spectacular results, and are for this reason somewhat more popular with the cultivators than the phosphatic or potassic fertilisers. So far as the cotton crop is concerned, either sodium nitrate or ammonium sulphate, depending upon climatic conditions, can be usefully employed Ammonium sulphate, though more safe than sodium nitrate as it is not leached out of the soil by washing, does not always give the best results. During the monsoon, for example, it has been observed several times that after long continued rainfall, waterlogging takes place and the natural process of nitrification in the soil is checked and the plants become stunted and yellow due to deficiency of available nitrogen. Under such conditions it has been found that the plants regain their lost vitality very quickly, become green and throw out new growth after a top-dressing of nitrate of soda.

Ammonium sulphate is not absorbed as such by a majority of crop plants as its nitrogen is required to be converted into nitrate with the help of soil bacteria. Under conditions of adequate moisture in the soil, ammonium sulphate will therefore be more advantageous than sodium nitrate for the following two reasons :—

(1) As already mentioned above, nitrogen from this fertiliser is held very firmly by the soil and is not therefore leached out of the soil.

(2) As the nitrogen is gradually converted into the available form of nitrate, a steady supply of this constituent is available in required quantities for a long time during the growth period of the crop.

Phosphatic fertilisers do not appear to give any spectacular results with ordinary crops and although their use may improve the quality of the produce and vigour and disease-resisting capacity of the plants, the advantage thus obtained may not compensate, in every case, for the extra cost of the fertiliser employed. Field experiments conducted with paddy on some of the farms in the Central Provinces have however shown that the use of superphosphate or bonemeal along with green manuring is more paying than green manuring alone.

Average soils do not appear to be deficient in potash and hence potassic fertilisers are not commonly used in ordinary farming. Potassic fertilisers on light soils with leguminous crops like groundnut have however been found to be very beneficial. Experiments conducted at Akola [Youngman and Janoria, 1927] with groundnut grown on local black cotton soil have proved that the most profitable fertiliser for this crop is sulphate of potash at the rate of 70 lbs. per

acre. The fertiliser should be applied at the time of sowing, being scattered by hand.

Potassic fertilisers have also been found to be very useful for sugarcane. They are reported to improve the quality of the juice by increasing the percentage of cane-sugar and reducing the percentage of invert sugar. Although phosphatic and potassic fertilisers may not show any spectacular results with ordinary field crops, their importance in vegetable gardening and horticulture should not be ignored and individual cases of garden crops will have to be dealt with separately, by giving due consideration to the local conditions of the soil and climate.

Finally, it may be added that the use of artificial fertilisers has not as yet achieved much popularity, not because fertilisers do not show the desired results, but because other factors like poor cultivation, use of local, mixed and some times deteriorated seed, and the world-wide economic depression, affect adversely and mask the effects brought about by the use of fertilisers. It appears rather inadvisable, therefore, for the present to lay any special emphasis on the use of fertilisers as a general practice of soil and crop management, but one feels confident that with improved methods of cultivation and an improvement in the general economic conditions, they are bound to acquire a stable footing in the agriculture of the average Indian farmer.

Regulation of soil moisture

The consumption of water by the various crop plants is very great and is estimated roughly to be 400 to 1,000 times the dry matter formed by the plant, under tropical conditions of climate. This requirement is reduced to a certain extent if an adequate amount of manure is added to the soil. At any rate it is not enough merely to supply the required quantity of water to the growing plants; it is also essential, as has already been mentioned before, that the soil should contain the right proportions of moisture and air, as in the absence of an adequate supply of the latter, the roots get asphyxiated, and stunted growth is the result. The beneficial soil organisms are also adversely affected and consequently there is a deficiency of available plant nutrients, particularly nitrates. The concentration of water in the soil which is necessary for good development of crops and the beneficial soil organisms varies largely with the nature of the soil. Leather [1911] found that in light soils ten to fifteen per cent moisture may produce good but not the largest crop growth, whereas in heavy soils like black cotton soil twenty-five per cent moisture in the soil is too small for anything but the most meagre growth.

Regulation of soil moisture can be achieved mainly by two methods, firstly, by having recourse to measures which are helpful in reducing to the desired extent the excess of water in the soil, and secondly, by artificial applications of water to the soil to make up the deficiency of moisture, or by controlling the absorption of rain-water and preventing its loss, by proper tillage. In the former case,

elaborate methods of under-drainage or the less costly method of constructing *kachha* underground drains can be adopted as desired. Adequate surface drainage, however, is very important and if properly provided for, goes a long way to check surface erosion and the ill effects of waterlogging produced on young growing seedlings. For checking surface erosion, a method which has been recently tried and found successful by Howard [1932] is described in the following extract. For fuller details readers are requested to refer to the original article :—

> " The land was laid out in suitable fields, each of which was provided with shallow trenches (nine inches deep, five feet wide at the top and two feet wide at the bottom, with sloping sides) and grass borders to remove its own excess rainfall. In this way the area was protected from outside water, and a rough-and-ready system of local drainage was provided for each field. Wherever possible rectangular plots, each eight acres in area, were made. Between every two plots there is, in addition to the surface drain, a grass strip eight feet wide which serves as a fair-weather road for the transport of produce and manure.
>
> After providing surface drainage, the grading of each individual field had to be undertaken. This was arranged for so that the run-off could reach a drain after it had travelled about 500 feet. If this distance was exceeded waterlogging took place. As the standard eight-acre plots measured 893·5 by 390 feet no difficulties were experienced when the field drained shortways. The run-off then reached a drain before any damage was done. In cases where the plots drained longways, an artificial depression about fifteen feet wide and six inches deep in the centre was scraped out (by means of the levellers used in grading) across the middle of the field, so as to intercept the run-off. This artificial trough, in the general surface of the field, communicated at both ends with the ordinary surface drains and served to protect the lower half of each field from the run-off of the upper half. To increase the efficiency of these depressions the soil which had to be removed in making them was arranged as a low, broad ridge on the down-side of the drain."

Whenever there is a shortage of natural soil moisture, water has to be provided for by artificial means either from irrigation tanks or from wells. When bringing new soils under artificial irrigation, the danger of the soil getting saline due to the rise of injurious salts to the surface from the subsoil by continued use of irrigation water should be guarded against. This can be avoided if proper precautions regarding the examination of the soil and subsoil are taken in time. The various departments of agriculture can give such help whenever required.

When water from a well is to be used for irrigation in addition to the usual examination of the soil, the water should always be examined for its suitability for purposes of irrigation. A number of instances have been met where by the continued use of undesirable well waters for irrigation, the soil has been spoilt and the crop has considerably suffered. Some well waters are absolutely unsuitable for irrigation but in many instances, with proper methods of soil management, the injurious effect of tolerable types of water can either be avoided or postponed for a number of years.

When well water is of medium quality (*i.e.*, when it contains sixty to eighty parts of total soluble salts of which about fifteen to twenty parts consist of sodium sulphate and sodium chloride) the effects produced are of a cumulative nature and are of two types : (1) if proper precautions are not taken from the beginning, quantities of sodium salts gradually accumulate in the soil at the expense of calcium and this spoils the tilth of the soil. The plants are therefore adversely affected by the undesirable physical condition, and by the direct effect of a high proportion of injurious sodium salts in the soil. (2) If however the soil has an adequate reserve of total and available calcium in it, the injurious effects are very considerably delayed and the situation is further improved if moderately deep channels are constructed at reasonable distances, so that the soluble salts accumulated in the top foot or two of the soil can be washed out with the help of the natural sweet water received during the rainy season.

In order to provide adequate quantities of lime, applications of lime as chalk or slaked lime together with gypsum are recommended. The exact quantity required will differ in individual cases and the advice of the department of agriculture should be sought, whenever necessary. It has recently been seen in many cases that the treatment suggested above has been of material benefit, both for the improvement of ordinary soils deficient in exchangeable and total calcium, and for the better utilisation of tolerable but not decidedly harmful types of well water by crop plants.

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DOYLE'S DISEASE OF FOWLS: ITS DIAGNOSIS AND CONTROL

BY

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RECENT investigations carried out in this province have shown that Doyle's disease is a very common—perhaps the commonest—disease of fowls in this province and a source of considerable economic loss to poultry owners both in the towns and in the rural areas. The disease is perhaps of equal seriousness in other provinces as well. Owing, however, to the fact that the disease was discovered but a decade ago its clinical and other features do not seem to be sufficiently well known and outbreaks of the disease when they occur are either not diagnosed at all or mistaken for fowl cholera. In view of the great importance of the disease it is the duty of all those who have to deal with fowl diseases to familiarise themselves with its more important clinical and other features so that they may be able to recognize it and adopt such measures for its control as are at present available. In this paper a description is given of some of the more important features of the disease whereby it may be recognized and of the measures which must be adopted and the principles which have to be observed in their application for the control of actual outbreaks.

HISTORY

Here it may be mentioned that what is here called Doyle's disease was formerly known as Ranikhet disease from the fact that it was first discovered in this country at Ranikhet in the Kumaun Hills. The disease was discovered in India by Dr. J. T. Edwards in 1927. A year before, *viz.*, in 1926, a similar disease had been discovered by T. M. Doyle, in England, on a poultry farm near Newcastle-on-Tyne, which he had described under the title of Newcastle disease. Outbreaks of a more or less similar disease were soon after reported under various names from many different parts of the world but it was soon proved that these so-called diseases were in reality all one and the same, identical with the Newcastle disease of Doyle in England. It was therefore proposed that these various names which were at best only confusing be dropped and that in accordance with the rules of priority the disease be called Doyle's disease after the name of the worker who had first described it.

Definition

Doyle's disease may be defined as an acute, febrile, contagious, infectious disease of fowls caused by a filter-passing virus and characterized by a difficulty in respiration and high mortality.

Animals susceptible

Fowls of all breeds are extremely susceptible to natural infection as also in a lesser degree ducks, geese and turkeys. The disease is also pathogenic for sparrows, pigeons and crows. A feature seen in most outbreaks is the death in large numbers of crows in the vicinity of farms and other localities where the disease is raging. The disease is not communicable to the larger animals or to man.

Incidence

The disease occurs in almost all parts of the province. It breaks out usually about June and July after the rains and outbreaks may continue up to December or January. Occasionally it may occur at other times of the year. In many areas in this Province the disease is enzootic subsiding during the extreme hot weather and breaking out again after the rains. The disease is extremely contagious and may spread in a short time over large areas causing enormous losses. It is also extremely virulent and if allowed to rage unchecked it may cause cent per cent mortality. This feature of the disease is of some importance as it serves to distinguish it from some of the other important fowl plagues in which as a rule the mortality is not so heavy.

Incubation period

The incubation period is on the average 3½ days, though at times it may be as short as two days and occasionally prolonged to fourteen days.

Symptoms

The disease may occur in an acute, peracute or chronic form.

In peracute cases the bird is usually found dead without any symptoms having been shown.

In acute cases there is a definite recognisable period of illness which lasts from two to three days and in the great majority of cases in a natural outbreak the disease runs an acute course. The disease is ushered in by fever, dullness and loss of appetite. Symptoms become gradually aggravated, the appetite becomes completely lost, dullness increases verging on complete drowsiness and the bird stands in a sleeping posture with the head either turned towards the ground or hidden under the wing. There is cyanosis of the comb and wattles and oozing of a thick sticky saliva from the mouth which hangs down from the beak in the form of a string. A whitish or yellowish-white diarrhoea is seen in the majority of cases which on account of its characteristic colour is often popularly likened

to *chuna* or lime. The vent is congested or inflamed and the vent feathers become soiled and matted together with yellowish-white excreta. A very important feature of the disease which may be regarded as pathognomonic of it is the peculiar long-drawn inhalation through the half-opened beak which is seen in about 50 per cent of the affected cases. In the later stages the bird becomes altogether paralysed and lies down resting on the breast or to one side with the eyelids closed and in an attitude of extreme drowsiness. Death soon supervenes. Just before the fatal termination there is a sudden fall of temperature which is very characteristic of the disease.

In chronic cases which run a more protracted course and which often end in recovery nervous symptoms predominate characterized by lameness, locomotor disturbances, paralysis of the legs, twitching of the head and neck, etc.

Recoveries occur in a few cases and such birds are permanently immune.

Mode of infection

The disease is usually introduced into a flock through the purchase of an infected bird or through infection conveyed on the hands, clothes, etc., of attendants. Crows and perhaps other wild birds play a very important part in the dissemination of the disease.

The usual mode of infection is by the ingestion of water and food stuffs contaminated by the oral and nasal discharges and the faeces of affected birds. These are extremely infective, particularly the saliva.

Post mortem findings

In quite a large number of birds the *post mortem* findings may be of an entirely negative character and nothing of any significance may be found. But in birds which have lived for a few days haemorrhages of various sizes are usually found in the lining of the proventriculus and the cloaca and in bad cases even ulceration. The presence of these haemorrhages in the situations named is extremely characteristic of Ranikhet disease. There may be a slight amount of congestion of other organs and occasionally small haemorrhages may be present also in the pericardiac sac, the heart-muscle and the gizzard fat. These, however, are extremely rare. There is also at times a catarrhal enteritis mostly confined to the duodenum and caeca. The mouth, pharynx and crop contain an excess of exudate and in protracted cases, loss of condition may be visible. On the whole what strikes one as the most characteristic feature of the disease on *post mortem* examination is the general absence of any gross pathological changes.

Diagnosis

Diagnosis may be established on the basis of the above-mentioned clinical and *post mortem* findings and in particular on the following features of the disease :—

(1) Its high infectivity and [extreme virulence with a mortality of 75 100 per cent.

(2) The presence of a whitish or yellowish-white diarrhoea.

(3) Oozing of saliva from the mouth.

(4) The characteristic dyspnoea.

(5) The general absence of any gross *post mortem* lesions or the presence of haemorrhages in the mucous membrane of the proventriculus and the gizzard, and

(6) The failure to demonstrate any organisms either in the blood or the tissues of affected birds.

Here it must be emphasised that though Doyle's disease has many characteristic features by which it may be recognized, these may not be present in every outbreak. Moreover, most infectious fowl diseases have many features in common which render an exact differentiation between them in the field at times an extremely difficult matter. In such cases the aid of a laboratory should be sought and appropriate materials including heart-blood on a swab and the internal organs, principally liver and spleen, of an affected bird or one which has just died of the disease should be submitted to a laboratory preserved in 50 per cent glycerine for examination.

CONTROL MEASURES

These resolve themselves into—

(1) Preventive inoculation or vaccination.

(2) Medicinal treatment, and

(3) Hygienic measures.

So far as the first two are concerned these may be dismissed very briefly. There is as yet no means of inoculation or vaccination available, whether curative or preventive, which may be considered to be of any value in the disease or whose use in the field may be regarded as a practical proposition Intensive research work, however, is at present in progress at various research centres in the country and it may be hoped that some tangible results in this regard will soon be forthcoming.

The same applies more or less to medicinal treatment. A large number of drugs have been tried but they have either not been found to be of much value or the claims made on their behalf have not been substantiated by experiments under controlled conditions in the laboratory. The only drugs which can be recommended, not so much for their curative value but as disinfectants or internal antiseptics are potassium permanganate and tincture of iodine. These may be added in minute quantities to the drinking water and to the water used for making feeds, as contaminated water is a most prolific source of infection in birds. Garlic and onion chopped up and mixed with the feed are credited with great therapeutic value by some and they may be tried as their use is not likely to do any harm if it does not do any good.

While on the question of medicinal treatment it may be emphasised that except in animals of value it is as a rule not advisable to attempt to treat sick or ailing birds in fowl epidemics for fear of risk of infection to other birds and in general it will be found that the immediate destruction of all affected and in-contact birds at the very commencement of an outbreak combined with the thorough cleaning and disinfection of poultry runs and houses is in the long run much the safer and more economical course. In the case of very valuable birds treatment may be attempted provided facilities for the thorough isolation of such birds exist. Similarly in small controlled flocks where the infection has already spread and a very large number of birds have become affected, treatment may be attempted with the object of salvaging any that may be brought back to recovery.

This leads us on to a consideration of hygienic measures and it may be stated at once that these are at present the only measures available on which reliance must be placed if the disease is to be effectively controlled once it has broken out in a flock. These measures, however, depend for their success on certain factors and their effective application is at times possible only in controlled flocks where the owner takes an intelligent interest in the matter, and is willing to go to the trouble and possible expense which their successful application involves. In villages owing largely to the ignorance of the owner, the low value of the average village fowl and his consequent lack of interest, their effective application may be fraught with many difficulties. But there are many intermediate stages between these extremes and since these are the only means whereby the spread of the disease can be checked and the losses minimized these should be given a trial wherever possible.

These hygienic measures comprise quarantine, isolation, disinfection, etc., which are in general familiar to all. No useful purpose will therefore be served by discussing them in detail and it will be sufficient if one indicates here only the general principles which should be followed in their application to the control of actual outbreaks, whether they be of Doyle's disease or any other infectious disease of fowls. What follows is meant to apply only to controlled flocks where full facilities for their application are available, but in the villages and in other places where there are often many difficulties of a practical nature the man on the spot will be the best judge as to what extent and in what way they should be altered or modified to suit the particular circumstances of each outbreak.

These general principles are as follows :—

(1) In healthy flocks an endeavour should be made to prevent the introduction of the disease by the isolation of all newly-purchased birds and birds returning from fairs and shows for a period of a fortnight.

(2) Crates, cages and utensils should always be disinfected after use.

(3) Attendants who have come in contact with diseased birds should wash and disinfect their hands and clothes before going near the healthy birds.

(4) As the drinking water is a fruitful source of spreading infection, only clean and pure water should be used and the drinking utensils should be such that they can be cleaned and boiled at least once a week. When disease has appeared a few crystals of potassium permanganate added to the water until it is faintly pink will minimise the chances of infection.

(5) Once a disease has appeared which is suspected to be of an infectious nature the affected bird should immediately be isolated without waiting for a definite diagnosis—a precise diagnosis may be attempted later—and the place thoroughly cleaned and disinfected.

(6) A more definite diagnosis must now be attempted and the aid of a laboratory may be sought, if necessary. Control measures should then be adopted to suit the particular outbreak.

(7) A strict adherence to the rules of poultry hygiene requires that all healthy birds should be removed from the houses or enclosures occupied by the diseased birds but owing to limitation of space and other difficulties of a practical nature this may not be found always practicable in which case the only alternative is to remove all the sick and in-contact birds.

(8) If infection has just started it will be found economical in the long run if all the affected and in-contact birds are promptly destroyed and disposed of either by burning or burial in lime. The litter, droppings, etc., should be removed and buried or burnt.

(9) Where infection has already spread extensively and a large number of birds have become affected, the entire flock may be destroyed, the premises thoroughly cleaned and disinfected and left unstocked for two months.

Methods of isolation, disinfection, etc.

For isolating infected or in-contact birds nothing very expensive or elaborate is required. Old packing cases, baskets, etc., or anything that can be easily destroyed may be used. Isolation should be rigid and complete and if possible separate attendants should be provided to look after the diseased birds.

For disinfection of houses, nest boxes, etc., 5 per cent phenyle solution liberally used is just as good a disinfectant as any other. Before disinfection is carried out all litter and refuse should be carefully removed and all wood work, walls, floors, etc., thoroughly scrubbed with a hot washing soda solution in the proportion of 1 lb. of the soda to each two gallons of water. The buildings may be

finally whitewashed after they have dried with a whitewash containing 5 per cent crude carbolic ($2\frac{1}{2}$ lbs. of crude carbolic acid to each five gallons of water).

Drinking utensils and other small articles are best disinfected by boiling.

Dry heat in the form of a flame is a very good and effective disinfectant and this may be employed for disinfecting articles which can stand this treatment.

Infective runs are not very easy to disinfect. It is best to dig them up and leave them unused for two months. Where the entire flock has been destroyed it is a wise precaution to leave the buildings vacant for at least two months before restocking them.

All dead and destroyed birds should be burnt or buried deeply in lime. The litter, droppings, etc., should be collected and disposed of in a similar way.

A SIMPLE AUTO-IRRIGATOR DEVICE FOR USE IN WATER-REQUIREMENT STUDIES OF SUGARCANE

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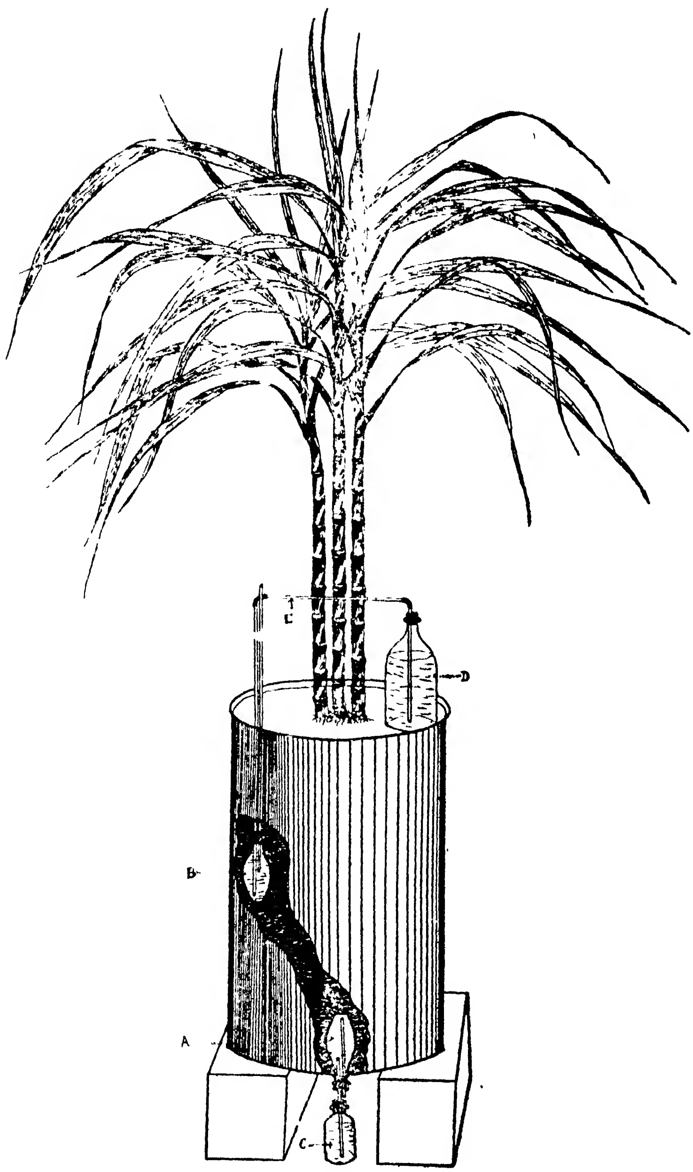
The gravimetric method so far extensively employed for studying water-requirements of crops has certain limitations when dealing with bulky crops like sugarcane, where large-sized containers are essential for the proper development of the plant; where equipment necessary for obtaining reliable weighment data is rather expensive, and where inaccuracy arising from the changing plant weight, in view of its large size, is pronounced. The methods of auto-irrigation developed by Livingston [1908] and subsequently elaborated by Hawkins [1910], Dustman [1925], Livingston, Hemmi and Wilson [1926], Deatrick [1927], Wilson [1929] and Richards and Blood [1934] although efficient were still too costly to be available to the field laboratories. Attempt was, therefore, made to simplify some of these elaborate devices and the system advocated by Deatrick [*loc cit.*] when suitably modified was found to answer the purpose very well and has since been adopted. As will appear from what follows the equipment as finally worked out is both simple and inexpensive and affords reliable data.

Description of the apparatus

The set for water-requirement studies (Fig. 1) comprises a container capable of holding about 500 kilos of well-pressed soil, a reservoir two to four litres capacity preferably graduated for convenience of recording the daily losses and two earthenware jars of about 1500 c.c. capacity each, to serve as 'drain' and 'supply' systems. The drain system consists of a jar (A) which is fixed at the bottom of the container by means of cement-sand and has two glass tubes protruding out of it—one to serve as an outlet for water and the other as an inlet for air. The outlet tube opens into a catch bottle (C) to collect the drain-off water, if any.

AUTO IRRIGATOR

A device for use in water requirment studies of sugarcane



Scale=1/20"=1"

Fig. 1

The supply system consists of a jar (B) which is fixed in position after filling the container with desired type of soil upto its middle and possesses two glass tubes long enough to stand fairly above the brink of the container. One of these tubes is connected to the reservoir (D) by means of a syphon arrangement (E) and the other serves as water-level index. The rest of the container is filled with the same soil and the surface is finally waxed to prevent absorption and evaporation of moisture from the soil.

After this has been done the jar (B) is supplied with water from the reservoir through the syphon, the rate of supply being controlled by the height of the reservoir head, the size of the supply jar, and the absorption capacity of the soil. Any water above the 'field capacity' of the soil drains off into the catch bottle. Normally this rarely happens except during the very early stages of plant growth. In actual working, known quantities of soil are filled in the containers and the soil moisture is determined separately in each case both at the start and at the end of the experiment. The total amount of water required to mature a plant is obtained from the difference between the residual moisture content at the time of harvest and the sum of (*i*) the aggregate quantity of water taken up day after day by the plant and (*ii*) the initial amount present in the soil before waxing the surface. In this way both the varietal and the seasonal water-requirements can be studied to appraise the suitability of different varieties and the critical phases of their growth.

Plate II, fig. 1 shows an experiment in progress on these lines at the Station. The normal growth of plants in all the fifteen sets belonging to five different varieties is obvious. One such set (Plate II, fig. 2) has been shown separately to bring out the supply and the drainage system prominently.

Working efficiency of the apparatus

Rate of water loss through plants at different times, distribution of soil moisture in the containers and root development in different layers, were studied to examine the working efficiency of the system. Data on daily water loss during a clear summer week when plants were young and not much developed, a clear monsoon week when they were passing through their grand period of growth and a clear winter week when they were approaching maturity, have been set forth (Table I) to demonstrate that the system can be employed for the study of seasonal water-requirements of the crop.

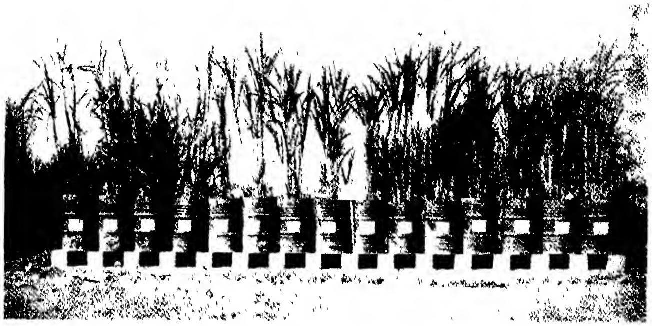


FIG. 1—Showing experiment on water-requirements of different varieties of sugarcane in progress. There is normal growth of plants in all the containers

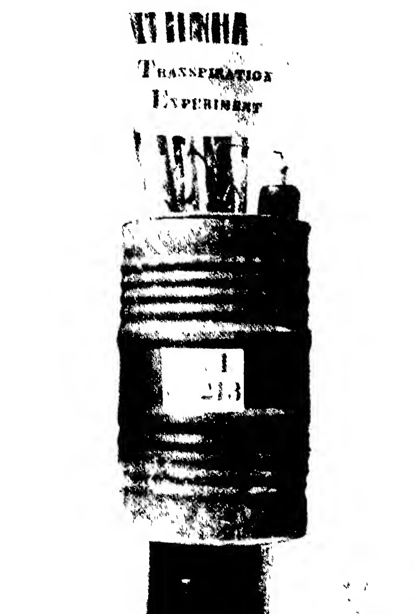


FIG. 2—One of the containers used in the above experiment shown separately, to bring out the 'supply' and 'drainage' system prominently

FIG. 3—One such container cut open to show the general development and the uniform distribution of root system

TABLE I

Showing daily losses of water at different times in variety Co. 210 growing in containers

Season	Date of observation	Mean. Temp. at 8.0 A.M.	Water transpired by Co. 210 plants I	II	III
		°F	c.c.	c.c.	c.c.
Summer week	18th May	83·7	2445	2320	2210
	19th ,, ...	88·2	2155	3050	3115
	20th ,, ...	91·7	2450	2910	2800
	21st ,, ...	90·7	2205	2495	2815
	22nd ,, ...	92·7	2345	2595	3015
	23rd ,, ...	86·7	2650	2765	2660
	24th ,, ...	86·7	2140	2330	2150
	Mean	88·6	2341	2638	2681
Monsoon week	28th Aug.	86·7	2320	2060	2500
	29th ,, ...	86·2	2410	2250	2500
	30th ,, ...	82·2	2135	1945	2710
	31st ,, ...	77·7	2235	2290	2520
	1st Sept.	94·7	1950	2050	2550
	2nd ,, ...	86·2	2200	2155	2550
	3rd ,, ...	88·2	2500	2445	2515
	Mean	84·6	2250	2171	2549
Winter week	28th Oct.	72·7	1690	1850	2050
	29th ,, ...	68·7	1500	1500	1810
	30th ,, ...	71·2	1480	1580	2000
	31st ,, ...	72·2	1425	1435	1675
	1st Nov.	73·2	1435	1575	1820
	2nd ,, ...	69·4	1305	1405	1295
	3rd ,, ...	69·9	1515	1435	1160
	Mean	71·05	1479	1540	1689

The distribution of soil moisture in the containers was studied by taking duplicate samples in six inches layer by the tube sampler and drying them to constant weight in air-oven at 95°-100°C. The results (Table II) showed the moisture distribution to be fairly uniform at different depths.

TABLE II

Showing moisture distribution in containers

Soil depth Inches	Average per cent soil moisture
0-6	20·14
7-12	20·17
13-18	22·32
19-24	24·10
25-30	23·69

The maximum water-holding capacity of the soil used in the experiment was 24·8 per cent and the data above presented would show this limit to have been rarely reached at any depth. Evidently the soil remained very well drained resulting in the normal growth of plants (Plate II, fig. 1). This was further borne out by the very uniform distribution of the active and total root-system (Plate II, fig. 3) which was discovered when the containers were cut open and the roots supported by fine wires were washed free of the soil. No partial crowding of the rootlets on the sides was noticed and the general development of finer branches confirmed the conclusions arrived at by Jones and Haskins [1927] that in non-porous containers the root-system was in proportion to the moisture present in different layers.

PRECAUTIONS NECESSARY FOR THE SUCCESSFUL WORKING OF THE SYSTEM

1. The reservoir and tubes should be kept clean to avoid algal growth which hinders the continuous flow of water into the supply jar. Any air collecting in the syphon should be forced out through the water-level index tube.

2. The connections between the supply tube and the reservoir should be horizontal and there should be as few rubber connections as feasible.

3. Before fixing the 'supply' and the 'drain' systems all joints should be tested air tight as leakage specially in the 'supply' allows undue saturation of soil and adversely affects the accuracy of the daily record.

SUMMARY

A simple auto-irrigator device for use in water-requirement studies of sugar-cane has been described and illustrated. Working efficiency from the point of view of (*i*) seasonal water-requirements, (*ii*) distribution of soil moisture in the containers and (*iii*) the development of root-system has been discussed. Precautions necessary for the successful working of the system have been enumerated.

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VITAMIN-A STUDY OF GHEE. PART V. EFFECT OF HEAT AND AIR ON VITAMIN A

BY

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In India ghee is regarded as a very valuable product and is consumed in large quantities. Besides being an important item of food, it is one of the chief sources of vitamin A. In tropical countries like India, milk and butter-fat cannot be stored indefinitely and so they are converted into ghee. Generally, the solidity, grain structure, colour, taste and aroma form the criteria for good quality of ghee. The quality of the final product is, however, greatly determined by the method of preparation and is dependent upon various factors, chiefly the time of boiling and exposure to air and light. In India the method has been practised for centuries but the whole process is largely empirical. However, French [1936] has recently studied scientifically the process of melting butter-fat into ghee and has given practical suggestions for making ghee which will withstand transportation and storage.

It is generally held that ghee is inferior to butter-fat in vitamin A content. This however is not the case, as the vitamin content of ghee, when fresh and properly prepared, is not inferior to that of butter [Datta and Banerjee, 1934]. The time occupied in the preparation, the temperature and method of boiling off of the water are factors affecting the vitamin content of ghee and should therefore be properly controlled. The value of butter-fat or ghee over other edible fats and oils lies in its vitamin content and if this is lowered or lost during heating or cooking then it offers no particular advantage over other fats. The only exception is palm kernel oil (Malayan) which is rich in vitamin A.

Since the study of vitamins was taken up, the action of heat on vitamin A content in butter-fat, cod-liver oil, and various other sources has attracted much attention. In spite of extensive literature on the subject the results on the extent of destruction caused by heat are not uniform or well established. As early as 1915, Osborne and Mendel steamed butter-fat for two hours and found that there was no loss of the growth-promoting factor. Heated for sixteen hours at 96°C butter was found to retain all the vitamin [McCollum and Davies, 1915]. These results led to the belief that the fat-soluble vitamin was comparatively stable to heat. However, as researches progressed data were not wanting to

cast doubt on the thermostability of vitamin A. Steenbock, *et al* [1918] found that aerating butter-fat at 100°C for twelve hours completely destroys vitamin A. When butter-fat is heated for four hours at 100°C so much of the vitamin is destroyed that no demonstrable amount remains. These authors further state that the destruction of the fat-soluble vitamin is not an oxidative reaction. Drummond [1919] regards heat as the chief cause of the destruction of vitamin A. According to him exposure of butter-fat at 100°C for one to four hours destroys vitamin A completely. The nutritive value of butter-fat is appreciably lowered by four hours exposure to a temperature ranging from 50°-70°C. Oxidation, however, plays no important part in the destruction.

Osborne and Mendel [1920] repeated their experiments and confirmed the results of their earlier experiments which indicated that vitamin A is resistant to heat. These authors heated butter-fat in an air bath at 96°C for fifteen hours without destroying any vitamin. Sherman, McLeod, and Kramer [1920] stated that " dry heating at a temperature of 100°C with free access of air, only very slowly destroyed vitamin A ". Hopkins [1920] confirmed Osborne and Mendel's results regarding the heat-resistance of vitamin A. His results show that vitamin A is relatively resistant to heat but is rapidly destroyed by exposure to atmospheric oxygen at temperatures ranging from 15° to 120°C. He observed that at 120°C in the absence of air there was not much loss even at the end of twelve hours. With aeration, however, the greater portion of the vitamin was lost in four hours. There was rapid destruction with aeration even at 80°C. Butter kept in thin layers at 15° to 25°C lost its vitamin content in about a week.

Drummond and Coward [1920] showed that vitamin A is destroyed at high temperature, provided facilities for oxidation are present. Thus heating at 100°C for six hours causes no destruction. Similarly, heating at 96°C for fifteen hours was without effect. But when heated at 96°C in the presence of air there is destruction even after three hours Heating at 50°C for six hours with air causes appreciable loss. Even at 37°C with extensive exposure to air there is rapid destruction of the vitamin. Drummond and Zilva [1922] found little loss to occur in the preparation of cod-liver oil from heat unless attempts were made to bleach the oil by methods involving oxidation. Similarly Daniels and Loughlin [1920] were unable to detect any loss of vitamin A by heat treatment.

The above results definitely establish that temperature alone has not much destructive effect on vitamin A and that oxygen plays an important role in destruction. Zilva [1920] observed that vitamin A is destroyed by atmospheric oxygen. Hess [1920] found that when milk is shaken with air it loses its vitamin potency. Drummond, *et al* [1921] observed that in the preparation of butter in the process of churning air gets incorporated and brings about oxidation Without exposure butter keeps well for eight months at low temperatures (below 10°C). Rancidity in butter caused by oxidation leads to vitamin A destruction. Steenbock and Sell [1921] heated butter-fat in shallow and deep vessels, in presence

and absence of oleic acid, with and without aeration, in carbon dioxide and in nitrogen but got no satisfactory results.

Most of the above experiments are only a qualitative demonstration. In some cases butter-fat upto the extent of fifteen per cent of the basal diet was given to the experimental animals which is rather too high to show any quantitative changes in the light of our modern knowledge. Further, Willimott and co-workers [1926, 1927] have found that in any given sample of fat, partial destruction of the vitamin either by irradiation or by aeration renders the remainder of the vitamin A present in the fat unstable. The vitamin content thus goes on decreasing and nearly half may be lost during the time required to carry out an animal experiment. It was only after 1927 when arsenic and antimony trichloride reagents were available that Wokes and Willimott [1927] obtained a temperature coefficient of destruction of vitamin A in cod-liver oil at temperatures between 85° to 125°C.

Attention has been drawn by several workers to factors other than heat and aeration which may play an important role in the destruction of vitamin A. Thus Dunn [1924] observed that vitamin A as it occurs in cod-liver oil is destroyed by mixing the oil with granulated starch and storing in the dark in corked bottles. Similar results were obtained with granulated lactose. Anderegg and Nelson [1926] noted a characteristic odour of decomposition when cod-liver oil was added to dry powders such as skimmed milk, whole milk, starch, or dextrin. Markus [1931] made the same observation when vitamin concentrates were mixed with various fine powders and stored. At first it was thought that the destruction is due to oxygen absorbed on the large surface of the powders. However, the same change is found to occur when the oxygen is replaced by hydrogen. The author concludes that finely divided substances bring about a condensation or polymerisation of vitamin A by virtue of the catalytic influence of surface effects.

Dann [1931] states that the general opinion regarding the stability of vitamin A towards heat and its ready oxidisability requires strict qualification. Hazley [1930] states that vitamin A is more stable than supposed. Cady and Luck [1930] demonstrated that vitamin A of cod-liver oil is not rapidly oxidised when treated with hydrogen peroxide. Scheunert [1931] has demonstrated that a large portion of vitamin A remains intact during the ordinary process of baking or roasting. Dann [1932] has found that vitamin A is readily oxidised by air when dissolved in some solvents and slowly or not at all in some others.

It will be seen from the literature above that the destruction of vitamin A in butter-fat is very complicated due to several factors which may come into play. At first heat was supposed to be the chief agent for vitamin A destruction; the importance of oxidation came to be recognised later on [Hopkins *loc. cit.*] The experiments of Markus [*loc. cit.*] do not lend support to the oxidation destruction theory. Dann's observations on the effect of solvents on the rate of oxidation of vitamin A are interesting and would suggest that the behaviour of

vitamin A in ghee, the fatty solvent, with reference to air and temperature, and in the form in which it is consumed in India, may prove interesting in several ways.

Experimental

The samples used in the present investigation were obtained through the kindness of the Imperial Dairy Expert, Bangalore. The butter employed in the preparation of the ghee was quite fresh and uncoloured. It was stored in a cold chamber. Ghee was prepared by first melting the butter in an air-oven at 100°C, until the aqueous layer collected at the bottom, leaving an uniform layer of fat above. The former was removed with a pipette and the molten fat filtered through cotton wool to free it from the scum. The clear molten fat was then heated till the ghee odour developed. Heating was done carefully (temperature not exceeding 110°-115°C) and just to the necessary degree (for about ten to fifteen minutes). All vitamin A determinations were made colorimetrically on the unsaponifiable fraction with the antimony trichloride reagent and expressed in Lovibond tintometer units [Banerjee, 1936].

1. *Effect of temperature on ghee.*—With a view to study the effect of varying temperatures on the vitamin A content, samples of ghee were kept in conical flasks in an electrically heated "Cenco" oven maintained at a definite temperature. The flasks were corked and samples removed at definite intervals of time for examination of vitamin A. Experiments were conducted at 75°C, 100°C, 125°C, 145°C, and 175°C respectively. The results are given in Tables I and II.

TABLE I

Effect of heat on vitamin A content of ghee

Obs. No.	Time of heating in hours	B. V.	R. V.	Vitameter reading
Temperature of heating—75°C				
1 . . .	0	14·3	..	43·2
2 . . .	5	14·3	..	43·2
3 . . .	10	11·0	..	43·2
4 . . .	22	..	..	38·4
5 . . .	27	8·8	..	41·6
6 . . .	43	6·8	..	52·8
Temperature of heating—100°C				
1 . . .	0	14·3	..	43·2
2 . . .	10	14·3	..	36·8
3 . . .	14	9·9	..	..
4 . . .	17	8·8	..	22·4
5 . . .	21	..	6·6	20·8
6 . . .	23	..	16·5	16·0

Obs. No.	Time of heating in hour	B. V.	R. V.	Vitameter reading
Temperature of heating—125°C				
1	0	14·3	..	43·2
2	1	14·3	..	38·4
3	2	11·0	..	36·8
4	3	11·0	..	38·4
5	5	7·7	..	30·4
6	7	Evanescent	..	20·8
7	8	..	6·6	16·0
Temperature of heating—145°C				
1	0	14·3	..	43·2
2	1	9·9	..	38·4
3	2	4·4	..	22·4
4	3	..	12·1	32·0

TABLE II

Heating at 175°C.

Obs. No.	Time of heating in minutes	B. V.	R. V.	Vitameter reading
1	0	14·3	..	43·2
2	5	13·0	..	40·0
3	10	12·1	..	36·8
4	15	11·0	..	36·8
5	20	5·0	..	36·8
6	27	Evanescent	..	30·4
7	30	Trace *	11·0	38·4

* The blue colour with the antimony trichloride reagent was not obtained when the usual quantity of the unsaponifiable fraction was used for vitamin A determination. However, when a large amount of the fraction was used blue colour developed, quickly changing to red.

2. *Effect of heat and aeration.*—To study the effect of air on ghee, compressed air from a cylinder was slowly allowed to bubble through a sample of ghee maintained at a definite temperature. Some trials were conducted with ghee maintained at 75°C and air bubbled at the rate of two or three bubbles per second. The results showed that the destruction was not very great as compared to that obtained by merely heating at that temperature. The experiments were repeated by maintaining the ghee at 100°C and passing air at different rates of five, ten,

and fifteen litres per hour respectively. A gasometer introduced in the circuit measured the quantity of cold compressed air that passed through the sample. The results are given in Table III.

TABLE III

Effect of heating ghee at 100°C and aerating at various rates

Obs. No.	Time in hours	Blue Value (control)	Blue Value (experimental)
Five litres per hour			
1	0	13·2	13·2
2	5	13·2	13·2
3	8	13·2	13·2
4	11	13·2	9·9
5	14	13·2	Evanescent
6	15	9·9	R. V. = 11·0
Ten litres per hour :—			
1	0	13·2	13·2
2	4	13·2	13·2
3	6	13·2	12·1
4	8	13·2	11·0
5	10	12·1	11·0
6	11	13·2	9·9
Fifteen litres per hour :—			
1	0	13·2	13·2
2	4	13·2	13·2
3	6	13·2	13·2
4	8	13·2	13·2
5	10	12·1	9·9
6	12	12·1	9·9

It may be seen from these results that air does not exert any appreciable influence on the stability of vitamin A in ghee. Several authors [Markus, 1931] maintain that water exerts a protective action. It was therefore thought that the above results might be due to small amounts of water carried along with the air. To verify this, the air was passed through sulphuric acid and soda-lime towers before being led into the hot ghee sample. The results did not differ in any way from those given above, thus showing that moisture was not the protective factor in our experiments.

Since dry or moist air does not affect the oxidation of ghee, it was felt necessary to examine the method employed critically. Ghee was not expected to show such a marked difference from the results obtained by Hopkins, Drummond, and others for butter-fat. In the above series of experiments cold air was bubbled through hot ghee. It is probable that the air may not be so potent in regard to its oxidising effect when cold as when heated and brought to the same temperature as that of the ghee. To verify this, air before bubbling through ghee was passed through a nichrome wire heating coil placed inside a silica tube and heated electrically. By adjusting the resistance, the temperature of air could be controlled. Air was bubbled at the rate of fifteen litres per hour. The results showed that even after twelve hours aeration with hot air there was not much difference in the values from those given in Table III.

3. *Autocatalytic influence of heat.*—It has been shown by Lea [1931], that the action of light is autocatalytic, that is, once the oxidation has set in the removal of the fat from the source of light does not prevent or reduce the change. The oxidation continues to proceed depending on the quantity of absorbed oxygen. It was considered of theoretical as well as practical importance to find out if heat produces similar changes to those induced by light. In the following experiments small bottles were filled to the neck with ghee and then corked. They were then kept at 100°C for five hours after which they were removed and kept at room temperature protected from light. A second series was repeated in which ghee samples heated at 125°C for thirty minutes were stored in a similar manner. The contents of the bottles were examined at weekly intervals. It was found that even after one month storage there was no destruction of vitamin A, thus showing that heat does not induce autocatalytic action.

4. *Effect of cooking on vitamin A content of ghee.*—In the preparation of food materials, ghee is subjected to three different types of treatment. Thus, in some products molten ghee is added or smeared; in these cases the temperature of the ghee is much below 100°C. In some cases, ghee is exposed to the temperature of boiling water, and the time of exposure depends on the nature of the preparation. In this type of cooking the temperature seldom exceeds 100°C. In yet other cases, where the preparations are fried in almost boiling ghee, the temperature is far above 100°C and may lie from somewhere between 150° to

225°C. In the former two cases one does not expect much destruction of vitamin A but in the last case there may be considerable vitamin A destruction depending on the time of exposure. To throw light on this point, some *puri* (patent wheat flour made out into thin rolls and then fried in ghee) was prepared in the laboratory according to the usual method. The temperature of the ghee at the commencement of frying was 180°C, but steadily rose to 212°C at the end of the operation. The yellow colour of molten ghee disappeared completely in about ten minutes thus indicating complete destruction of vitamin A. About 150 grms. of *puri* were then extracted with ether and the vitamin A estimated in the unsaponifiable fraction of the extracted fat. There was only a faint trace of vitamin A in the extract. The preparation, however, tasted well.

5. *Action of heat on cow and buffalo ghee.*—In the above experiments it was observed that destruction of yellow colour of the ghee samples ran parallel with the rate of destruction of vitamin A. Since in our experiments we had used uncoloured samples of butter, the yellow colour was mostly due to carotene. In artificially coloured samples of butter this relationship would not naturally exist. In view of the fact that cow ghee is richer in carotene than buffalo ghee, it was thought of interest to compare the relative stabilities of the two. Buffalo ghee was prepared from a fresh sample of butter by the same procedure described for cow ghee. The two samples were placed in conical flasks which were closed with corks and placed in an air-oven at 100°C. They were examined for their vitamin A content at different intervals. The results are given in Table IV.

TABLE IV

Stability of cow and buffalo ghee to heat

Obs. No.	Time of heating in hours	Blue Value (cow ghee)	Blue Value (buffalo ghee)
1	0	14·3	14·3
2	5	14·3	14·3
3	10	14·3	7·0
4	15	9·9	Trace *
5	20	Trace *	

*The blue colour with the antimony trichloride reagent was not obtained when the usual quantity of the unsaponifiable fraction was used for vitamin A determination. However, when a large amount of the fraction was used blue colour developed, quickly changing to red.

Discussion

From the various experiments conducted in the course of the above investigations, two points are well brought out: (1) the destruction of vitamin A in ghee under the action of heat is not progressive. After a certain interval it drops suddenly (Fig. 1) and once the destruction has set in the decomposition proceeds rapidly; (2) the loss of the yellow colour of fresh ghee runs parallel with the destruction of vitamin A. Antimony trichloride reagent does not give pure blue colour usually attributed to vitamin A with ghee samples. There is always a trace of yellow or green. However, artificially coloured samples (containing annato) give a beautiful blue colour. Annato when tested alone with antimony trichloride gives a pink to deep red colour depending on the dilution. The destruction of vitamin A is followed by the appearance of a red colour, instead of blue, with the usual method of vitamin A estimation (Tables I and II). The special significance of this red colour is under investigation.

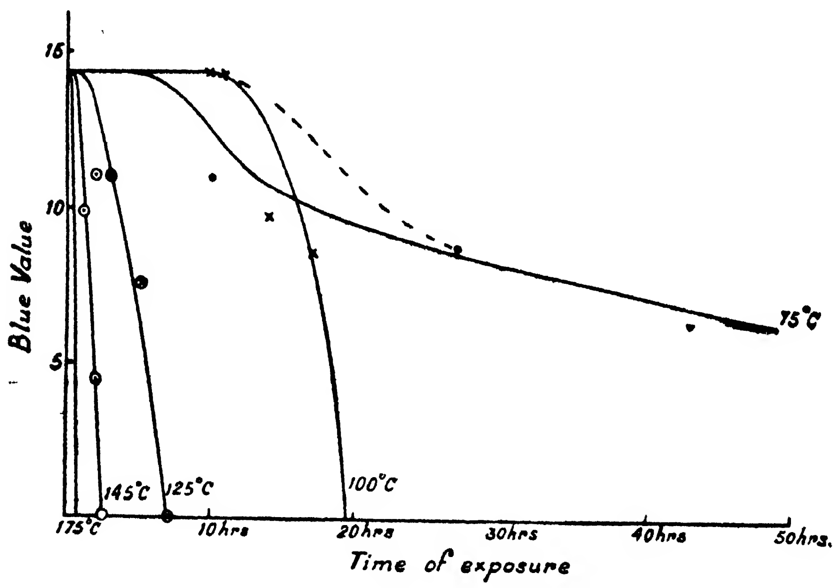

Fig. 1—Effect of heat on vitamin A.

Vitamin A in ghee is markedly resistant to heat upto a temperature of 100° to 120°C. Beyond this it is destroyed quickly and above 150°C there is very rapid destruction. Hence food preparations made at a temperature exceeding 120°C are almost devoid of vitamin A. Such preparations will in no way be superior in their nutritive value to those obtained by using other oils and fats. The method of cooking thus needs to be carefully controlled if vitamin losses are to be avoided.

The effect of aeration in conjunction with high temperature is to reduce the time of destruction of vitamin A in ghee. However, the effect is not so marked as has been attributed by previous workers. The temperature of air used for aerating samples of ghee has no appreciable influence. Further, the reduction in time of destruction is almost independent of the volume of air passed (Table III).

The relative stabilities of cow and buffalo ghee toward heat is very interesting. The former is richer in yellow colour and takes about twenty hours for complete destruction of its vitamin A content. On the other hand, buffalo ghee having an identical vitamin A content is stable under similar conditions only for fifteen hours (Fig. 2). It has been suggested [Bradway and Mattill, 1934; Olcott, 1934] that carotene lowers the stability of vitamin A. If this were so, then it would appear that there are other factors in cow ghee—probably lipochromes—which make it more resistant to heat than buffalo ghee.

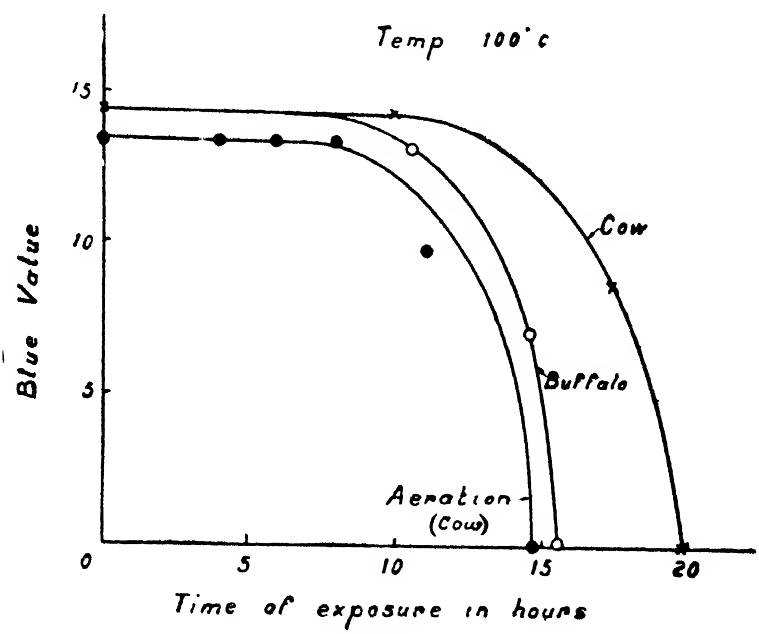

Fig. 2

Summary

1. Vitamin A in ghee is fairly stable at temperatures upto 125°C, but is rapidly destroyed at higher temperatures.

2. Aeration of hot ghee samples lowers the stability of the vitamin. The rate of destruction of vitamin A is independent of the temperature an volume of air used for aeration.

3. Heat does not induce autocatalytic action as is attributed to light.

4. Cow ghee is superior to buffalo ghee in regard to the stability of its vitamin A towards heat.

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A PRELIMINARY NOTE ON THE POSSIBILITIES OF BREEDING NEW VARIETIES OF SUGARCANE UNDER NORTH BIHAR CONDITIONS

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CONTENTS

I. Introduction

Bihar conditions have always been considered too severe to enable cane to produce fertile flowers. This has been largely due to the fact that the indigenous canes rarely flowered and that flowering in their case was believed to be ' a very ominous occurrence ' [Watt, 1893]. While studying Bihar canes Barber [1915] found rare flowering and shy anther dehiscence. Woodhouse, Basu and Taylor [1915] describing the canes of Bihar and Orissa mentioned only Khelia, Pansahi, Khari, Shakerchynia and Maneria as having a tendency to flower, Khelia alone showing anther dehiscence worth the name. The position seems to have changed since the introduction of Coimbatore seedling canes in 1919. Flowering has become more common particularly in the case of varieties that have in them immediate blood of *Saccharum spontaneum*. Thus Co. 205 flowered more or less everywhere in Bihar in 1920, though the degree of flowering varied a great deal in different places [Pusa, Sugar Bureau Records]. Other Coimbatore varieties such as Co. 213 and Co. 210 have also steadily got acclimatized and have shown increasing tendency to flower from year to year (Table I).

TABLE I

Percentage of flowering in Co. 213 and Co. 210 in North Bihar in different years*

Year	Percentage flowering in	
	Co. 213	Co. 210
1926	1·9	—
1927	2·6	—
1928	3·8	0·7
1929	3·0	1·0
1930	9·9	—
1931	17·6	2·4
1932	10·4	—
1933	13·7	1·8
1934	16·6	3·1

*The data for 1926 to 1931 are taken from Pusa (new area) records through the kind courtesy of the Imperial Agriculturist and the new area staff. The other figures refer to author's own observations at Musheri.

More recently the author has observed some of these varieties flowering as early as October and as late as April at different places in Bihar. Two more of the indigenous canes namely ' Bhoria ' and ' Hathni ' which belong respectively to the *Mungo* and *Nargori* groups of Barber [1916], have been found flowering to a varying degree in parts of Saran district in North Bihar. Other introductions from Coimbatore in recent years have also shown a tendency to flower, some flowering profusely in the very first year of their arrival, so that at the sugarcane testing stations over 50 per cent of the seedlings under trial are at times found arrowing in the season.

In view of the possibility suggested by Howard [1924] it seemed likely that some of the most profusely flowering canes at any rate might be fertile in the male and female and viable seed might form if the arrows could be protected from the low temperatures that prevail in Bihar towards their maturity period. This viable seed if formed would offer possibilities of raising large number of seedlings ' which will be introduced to the Bihar climate at an earlier stage in their history and by studying their growth, under the conditions for which they are intended it may be possible to discern both earlier and more accurately those types which are best suited to withstanding the diseases and climate of Bihar ' [Shaw, 1925].

II. EXPERIMENTAL

The opening of the Sugarcane Research Station in Bihar and Orissa in 1932 with the funds granted by the Imperial Council of Agricultural Research, afforded facilities for a detailed study of the floral parts with a view to exploring the possibilities of producing viable seed and raising seedlings under Bihar conditions. Some forty Coimbatore varieties were under trial during the first year and a number of them gave indications of arrowing in the month of October. The

varieties Co. 205 and Co. 285 growing in the lowland were the first to be in " short blade "*. They were artificially rooted according to the Coimbatore method [Venkatraman and Thomas, 1926] and were brought to the pot culture house during the first week of November when the arrows were just about to emerge. These were laid flat on the ground with the rooted portion placed in a pit full of admixture of sand and soil and were trained [Mercado, 1926] for convenience in handling the arrows. The canes were watered twice daily with 0·1 per cent solution of double superphosphate which practice has since proved very useful. Thatched bamboo-sheds were erected for a set of ten arrows of each of the two varieties as soon as they made appearance through the encircling sheaths. Five plants of each of the varieties under study, emerging their arrows on the same date as those inside the sheds, were labelled in the field to serve as control for the detailed study of seed setting under the two conditions. A number of other varieties which were artificially rooted in October were similarly treated and separate sheds allotted to each set of ten protruding arrows.

The idea in providing sheds was to afford the emerging arrows more or less the same conditions as are obtained at Coimbatore during the arrowing season with regard to atmospheric temperatures and humidity. Reference to the meteorological records of the two places (Table II) showed weather conditions at Coimbatore to be much milder than they were in Bihar. Though variations in maximum limits of temperature were not very wide, those in minimum temperatures at times exceeded by over 20°F while the humidity at Coimbatore during the cold months was always found to be high. Also that fluctuations in day maximum and night minimum were more pronounced in Bihar.

TABLE II

Meteorological data† at Coimbatore and Masheri (average of ten years)

Months	Coimbatore			Masheri		
	Maximum	Minimum	Relative humidity	Maximum	Minimum	Relative humidity
September	90·2	70·9	74·4	90·4	77·9	85·0
October	88·2	70·8	78·1	88·7	70·8	78·1
November	84·2	68·1	80·9	82·2	58·6	73·0
December	83·6	65·8	76·8	77·1	50·4	71·4
January	85·7	64·4	77·7	75·7	44·3	69·7
February	89·5	65·3	71·3	80·4	51·8	63·2

* [illegible] accompanied by much shortening of leaf lamina.

† The comparative data for Masheri and Coimbatore are taken respectively from the records of the Imperial Institute of Agricultural Research, Pusa, and the Agricultural College and Research Institute, Coimbatore, through the kind courtesy of the Agricultural Chemists at the two institutions. Masheri is only 18 miles from Pusa.

The sheds were artificially heated from 4-30 in the evening to 8-30 in the morning to prevent minimum temperatures falling below 60°F. Early in November only a petromax lamp burning the whole night was enough to keep the desired temperature, while in December hearths specially designed to serve the purpose had to be placed in addition inside the sheds after ten in the night. Paraffin heating stoves proved quite suitable for regulating the higher ranges of temperature but they could only be used in sheds where there was no danger of any drought. Additional arrangements to circulate smoke in covered pipes with a view to raising temperature had to be made during the period of frost.

To raise soil temperature and humidity inside sheds, pits containing artificially-rooted canes were heavily irrigated in the evening with superphosphate solution which had been warmed by the sun for the whole day and recorded a temperature of 91°-97°F. This helped to keep the humidity inside sheds round about 75 per cent saturation while outside it varied between 48·5 to 56·2 per cent saturation and the soil temperatures 6·2°F above those recorded outside in the open. Water emitting sprays were provided on days when atmospheric humidity inside sheds was found to be below 55·0 per cent. The sheds were closed every day in the evening and were opened next morning. On windy days, however, the side thatches were not disturbed and the roof only was removed to allow of sunshine. Tarpaulin roofing was used in the event of rain. The investigation embraced the study of the following points :—

(*i*) Time of anthesis and anther dehiscence, (*ii*) Pollen shedding and viability, (*iii*) Stigma receptivity, (*iv*) Fertilization, (*v*) Seed development, (*vi*) Viability of seeds and (*vii*) Raising seedlings.

III. Results obtained

(*i*) *Time of anthesis and anther dehiscence.*—The first flower opening was found to take place between the hours 8-05 A.M. and 8-30 A.M. during the first week of November and between 9-05 A.M. to 9-35 A.M. during the first week of December. Towards the end of December the time of flower opening was observed to be as late as 10-0 A.M. (Table III). On clear days arrows in the field and those under sheds opened simultaneously while on cloudy days in December the former showed earlier anthesis. The reaction of different varieties to cloudy weather varied a good deal and in the case of Co. 325, the time of flower opening was observed to be as late as 3-0 P.M. although normally on clear days very few flowers opened after 12-45 A.M. It may be of interest to mention that the usual time of commencement of flower opening at Coimbatore is between 5-30 A.M. to 6-45 A.M. and the late flower opening in Bihar might indicate the influence of environment and sub-tropical type of climate or the time of opening of flowers in cane.

TABLE III

*Time of anthesis under Bihar conditions: Variety Co. 285**

Date	Time of first opening of flowers	Time upto which flowers were opening
	A. M.	A. M.
3rd November 1932	8-5	10-00
4th November 1932	8-8	9-30
5th November 1932	8-5	9-40
6th November 1932	8-10	9-40
7th November 1932	8-17	10-20
10th November 1932	8-30	10-20
13th November 1932	8-30	10-26
14th November 1932	8-35	10-30
15th November 1932	8-40	10-25
16th November 1932	8-42	10-30
20th November 1932	8-50	10-40
24th November 1932	8-50	11-00
25th November 1932	8-55	11-36
28th November 1932	9-05	11-40
4th December 1932	9-05	11-30
5th December 1932	9-10	11-28
6th December 1932	9-10	11-25
9th December 1932	9-20	11-25
10th December 1932	9-27	11-45
11th December 1932	9-35	11-40
12th December 1932	9-30	12-15
13th December 1932	9-30	12-00
17th December 1932	9-34	12-00
22nd December 1932	9-40	12-10
23rd December 1932	9-40	12-30
24th December 1932	9-38	12-10
28th December 1932	9-46	12-15
29th December 1932	10-4	12-35
30th December 1932	10-10	12-45
31st December 1932	10-10	12-40
2nd January 1933	10-00	12-40

*Most of the other varieties behaved similarly.

A good deal of difference was, however, observed in the shedding of pollen inside sheds and in the open. Whereas under the sheds, dehiscence of anthers took place almost immediately after anthesis and pollen was normally shed, this varied a great deal from day to day in the field grown arrows and appeared to be markedly influenced by the prevailing weather. On cloudy days pollen shedding was delayed till 11-0 A.M. and on the 29th of December when frost was experienced, no pollen shedding took place till 3-30 P.M. (Table IV). The anthers examined on subsequent days were found to be shrivelled and brown yellow in colour.

TABLE IV

Pollen shedding under controlled and field conditions

Date	Temperature			Nature of the weather	Time when dehiscence of anthers took place	
	Maximum	Minimum	Relative humidity		Under shed	In field
					A. M.	A. M.
21st Nov. 1932	84·1	54·3	50·0	Bright and slightly breezy	8-50	9-35
22nd Nov. 1932	84·5	51·7	48·5	Ditto .	9-00	9-40
23rd Nov. 1932	81·9	50·0	49·7	Ditto .	8-56	9-50
10th Dec. 1932	76·7	47·5	49·8	Bright and windy .	9-30	9-40
11th Dec. 1932	77·0	45·0	37·5	Bright . . .	9-38	9-40
12th Dec. 1932	80·3	47·0	60·6	Ditto . .	9-36	9-50
27th Dec. 1932	78·4	46·8	48·6	Cloudy and windy .	9-40	11-10
28th Dec. 1932	73·0	39·0	52·4	Bright and windy .	9-56	12-40
29th Dec. 1932	75·5	33·4	44·0	Cloudy and windy. .	10-20	No anther dehiscence till 3-30 P.M.
30th Dec. 1932	70·2	38·6	49·9	Bright . . .	10-20	11-30
31st Dec. 1932	73·1	43·2	52·4	Bright and breezy .	10-10	11-00
2nd Jan. 1933	63·3	41·1	52·8	Cloudy and breezy .	10-05	10-48

Different varieties were examined for their pollen-shedding capacity and for determining the percentage of open or closed anthers [Khanna, 1933] both under shed and field conditions. In almost every case examined (Table V) the percentage of closed and shrivelled anthers was found to be higher in the latter case.

It was interesting to observe varieties Co. 281 and Co. 331 which had preponderance of closed anthers in December, showing a very high percentage of open anthers in February and March. The former variety was successfully employed as male parent during these months.

TABLE V

Anther dehiscence in different varieties of cane (average of two years)

Name of variety	Under sheds		In field	
	Percentage open anthers	Percentage shrivelled and closed anthers	Percentage open anthers	Percentage shrivelled and closed anthers
Co. 205	67·8	32·2	54·6	45·4
Co. 213	10·3	89·7	3·4	96·6
Co. 214	57·9	42·1	34·6	65·4
Co. 285	70·5	29·5	60·0	40·0
Co. 299	1·8	98·2	0·4	99·6
Co. 300	8·4	91·6	1·1	98·9
Co. 312	14·9	85·1	4·8	95·2
Co. 313	16·0	84·0	2·9	97·1
Co. 318	76·2	23·8	51·5	48·5
Co. 320	9·4	90·6	1·9	98·1
Co. 323	48·6	51·4	29·4	70·6
Co. 325	51·0	49·0	20·7	79·3
Co. 326	90·4	9·6	85·0	15·0
Co. 330	85·1	14·9	59·4	40·6
Co. 332	9·0	91·0	1·4	98·6
Co. 342	21·4	78·6	14·4	85·6
Co. 346	83·0	17·0	70·0	30·0

The low temperatures that prevail in Bihar in winter would appear to have restricted both the normal development of anthers and their dehiscence and this knowledge might prove useful in crossing two varieties which possess plenty of pollen of their own by subjecting one of them to low temperatures. The purple to deep purple colour of anthers as was met with in the case of varieties Co. 205, Co. 285, Co. 326 and Co. 346 was found to be associated with higher percentage of open anthers which as will be shown subsequently yielded more viable pollen.

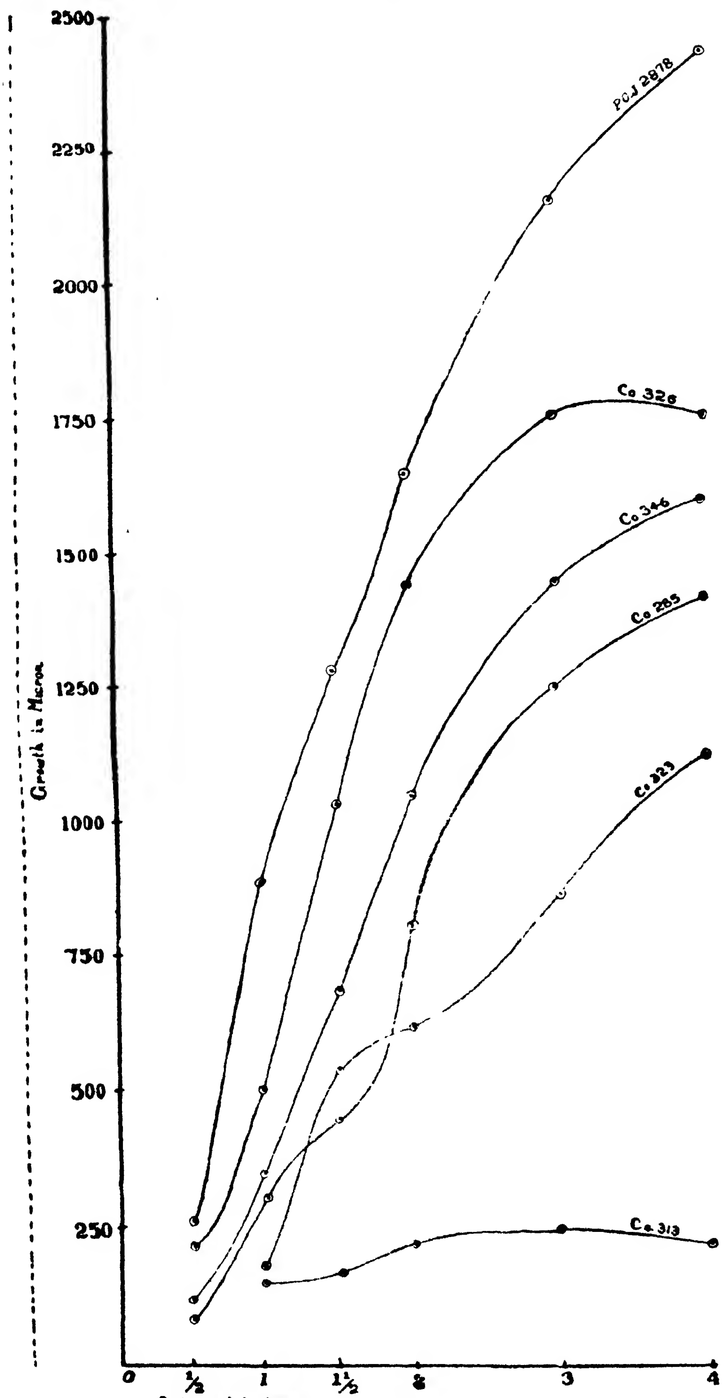
(*ii*) *Pollen shedding and viability.*—Pollen grains were found to be normal in size and shape and showed deep blue stain with iodine solution. The viability was tested by germinating them in sugar media [Dutt and Ayyar, 1928] and it was found that in a number of varieties pollen was quite viable and long tubes some measuring 1267μ were obtained within thirty minutes to an hour. Pollen collected from freshly-opened flowers in the field gave comparatively fewer germinations (Table VI).

TABLE VI

Average per cent viable pollen as determined by germinating in sugar media

Variety	Pollen collected from arrows inside sheds	Pollen collected from arrows grown in the field
Co. 205	41·4	17·1
Co. 213	Immature grains no germination	..
Co. 285	45·2	26·2
Co. 300	No germination	..
Co. 312	19·3	12·6
Co. 313	18·4	6·4
Co. 318	19·9	11·3
Co. 323	29·4	5·1
Co. 325	41·2	7·0
Co. 326	59·6	34·2
Co. 332	4·9	..
Co. 342	27·6	4·4
Co. 346	57·3	12·9
Co. 356	48·6	19·8
P. O. J. 2878	46·1	29·4

The rate of pollen-tube growth varied with pollen belonging to different varieties, heavy pollen-shedding varieties showing relatively quicker rate of growth (Fig. 1). Pollen tubes did not grow very long in the case of varieties Co. 323 and Co. 313. In the latter case they were found to be encircling the pollen grains. In both these cases very poor setting was obtained. Viability of pollen was also found to vary considerably in a season and in different localities. During November and early December pollen was found to be more viable than that formed later in the season, and in spite of the more favourable conditions as regards temperature and humidity rather poor results were obtained as the few seeds that were produced were frequently shrivelled and under developed. Examination of pollen collected during the month of January at Sepaya, Masheri and Patna brought out (Table VII) the influence of conditions of growth on the viability. Pollen from 'Usar land' plots was invariably found to be less viable than that obtained from the heavy lowland ones [Venkatraman, 1925.]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2250
2000
1750
1500
1250
1000
750
500
250
Growth in Micron
0
½
1
1½
2
3
4
Interval in hours
POJ 2878
Co 326
Co 346
Co 285
Co 323
Co 313

FIG 1

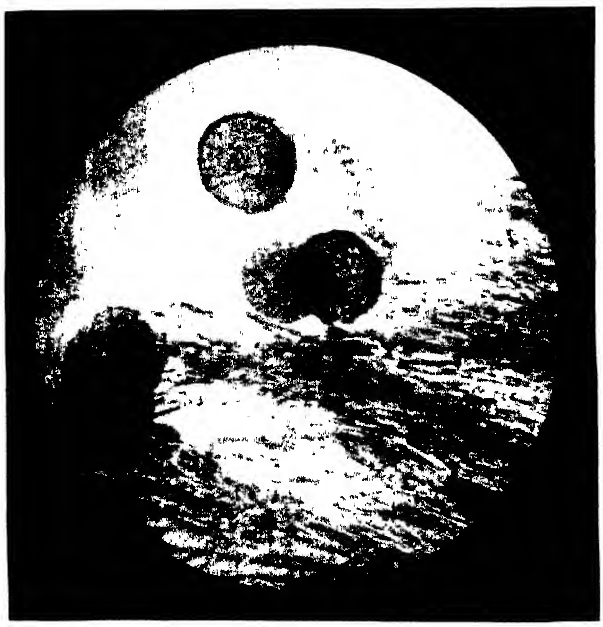
TABLE VII

Effect of locality on pollen viability

Varieties studied	Per cent viability of pollen as tested in sugar media		
	Masheri on 20th Jan. 1933	Patna on 9th Jan. 1933	Sepaya on 12th Jan. 1933
Co. 285	16·3	18·5*	10·7
Co. 326	35·7	12·4	..
Co. 313	5·9	1·4	5·8
Co. 312	11·4	9·7	1·8
Co. 325	6·1	..	2·9
Co. 346	16·9	4·9	2·2
Co. 356	29·8	21·1	11·4

*Lowland crop.

(*iii*) *Stigma receptivity.*—To find out if stigmas were receptive to their own or foreign pollen, they were collected from freshly-pollinated flowers of selfed and crossed arrows in a watch-glass containing solution of cotton-blue [Dutt and Krishnaswamy, 1931]. The stigmas were left in the stain for five minutes after which they were removed and the excess stain washed out by passing them through a watch-glass containing distilled water. On examination under the microscope pollen grains and pollen tubes which were stained dark blue were easily differentiated from the purple stigmatic papillae and the counts of the germinating pollen grains were easily made (Plate III). For comparison of receptivity under the two conditions, 100 stigmas from freshly-opened flowers were removed at random in the case of varieties that were being studied inside sheds and in the field and the results (Table VIII) showed that there were larger number of pollen grains found germinating on the stigmatic surface in the case of flowers taken from the arrows inside sheds. The field collections showed very poor germinations which might be attributed to the drying up of stigmatic surfaces owing to low atmospheric humidity outside. Quite satisfactory germinations, however, were obtained in the field in the case of varieties Co. 326 and Co. 346 but poor setting resulted.



Photomicrograph of germinating pollen-grains on stigmatic hair differentiated by cotton blue × 500

TABLE VIII

Stigma receptivity under controlled and field conditions

Year	Variety	No. of stigmas examined	Shed			Field		
			Total No. of pollen grains present	No. found germinated	Per cent germination	Total No. of pollen grains present	No. found germinated	Per cent germination
1932-33	Co. 285	100	4,742	1,983	41·8	3,012	249	8·2
	Co. 312	100	917	102	11·1	699	64	9·1
	Co. 325	100	2,133	519	24·33	1,414	57	4·3
	Co. 326	100	7,285	2,871	39·4	5,950	1,228	20·6
	Co. 346	100	6,219	2,070	33·2	5,162	936	18·1
1933-34	Co. 285	100	2,667	877	32·9	1,905	173	9·1
	Co. 312	100	1,208	259	17·3	567	52	9·2
	Co. 326	100	6,875	3,011	43·8	5,229	1,406	26·9
	Co. 346	100	4,102	1,132	27·6	2,692	393	14·6
	Co. 356	100	5,961	2,694	45·2	4,081	959	23·5
	P. O. J. 2878	100	4,854	1,854	38·2	4,020	872	21·7

The beneficial effect of humidity on the stigma receptivity was incidentally brought out through the overheating of one of the sheds where eight out of the ten arrows got partially damaged and showed very few pollen germinations in vitro while the two arrows which happened to be near the water-emitting spray gave fair number of germinations. This was later confirmed in the field where by creating artificial conditions of high humidity, stigmas could be made to hold more pollen which germinated readily (Table IX).

TABLE IX

Effect of humidity on stigma receptivity

Year	Treatment	No. of stigmas examined	Total No of pollen grains found on stigmas	No. that was found germinating	Per cent germination
1932-33 .	Control	100	2,914	235	8·1
	High humidity (under effect of shower) . .	100	3,685	551	14·9
1933-34 .	Control (42·0 per cent saturation) . . .	100	3,912	571	14·6
	High humidity (67·74 per cent saturation) . .	100	4,957	1,343	27·1

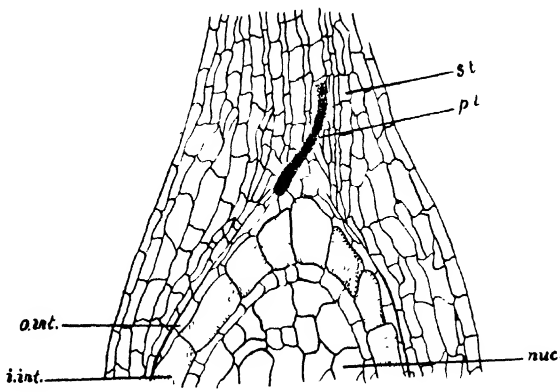
Similarly arrowed canes which received irrigation daily and had water stagnating round their bases also showed better stigma receptivity (Table X). Better setting in later years have resulted from arrows subjected to this treatment in the seedling house.

TABLE X

Effect of daily irrigation and stagnation of water on stigma receptivity

Year	Variety	No. of stigmas examined	Irrigated			Unirrigated		
			No. of pollen grains present	No. found germinated	Per cent germination	No. of pollen grains present	No. found germinated	Per cent germination
1932-33	Co. 285 .	317	9,321	1,211	13·0	7,266	581	8·0
	Co. 205 .	200	4,417	862	19·5	4,055	486	12·0
	Co. 326 .	100	5,849	2,076	35·5	4,917	1,175	23·9
1933-34	Co. 356 .	100	4,219	1,148	27·2	3,841	860	22·4
	Co. 285 .	100	3,437	864	16·4	2,119	218	10·3

(*iv*) *Fertilization.*—To study behaviour of the pollen-tubes inside stylar tissue and ovary and to see if fertilization took place, necessary material was fixed in acetic-alcohol at intervals of two hours for twenty-four hours after pollen shedding and embedded in paraffin. Sections 10 μ to 12 μ thick were cut. They were stained in anniline blue and differentiated by magenta red [Stout, 1931]. On examination pollen-tubes which were stained light purple were traced to be making their way through the stylar tissue into the ovary. In none of the slides prepared from material fixed six hours after pollen shedding, were pollen-tubes traced beyond the end of the style (Plate IV, fig. 1). In preparations from the material fixed twelve hours after pollen shedding the pollen-tubes were found to have reached the embryo-sac (Plate IV, fig. 2). In no one section was the tube traced all along its course but the whole course of the pollen-tube through the stylar tissue and the ovary could be reconstructed from a number of slides showing different positions (Fig. 2). The preparations made from the material collected 24 hours after pollination gave an indication of the formation of the endosperm. The material collected from the field with the same object in view showed normal development of the pollen-tubes in the case of Co. 285 only where they were found to have reached the embryo-sac. In the other cases examined, no pollen-tube could be traced inside the style or the ovary tissue. Dutt and Subba Rao [1933] have shown fertilization to take place within about seven hours under Coimbatore conditions. At Masheri, however, in almost every case examined this took



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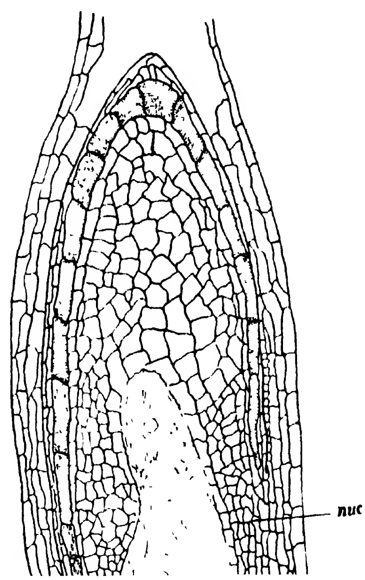

between ten to twelve hours. This longer period taken by the pollen-tube to reach the embryo-sac might be attributed to either differences in climate or differences in the varieties under observation.

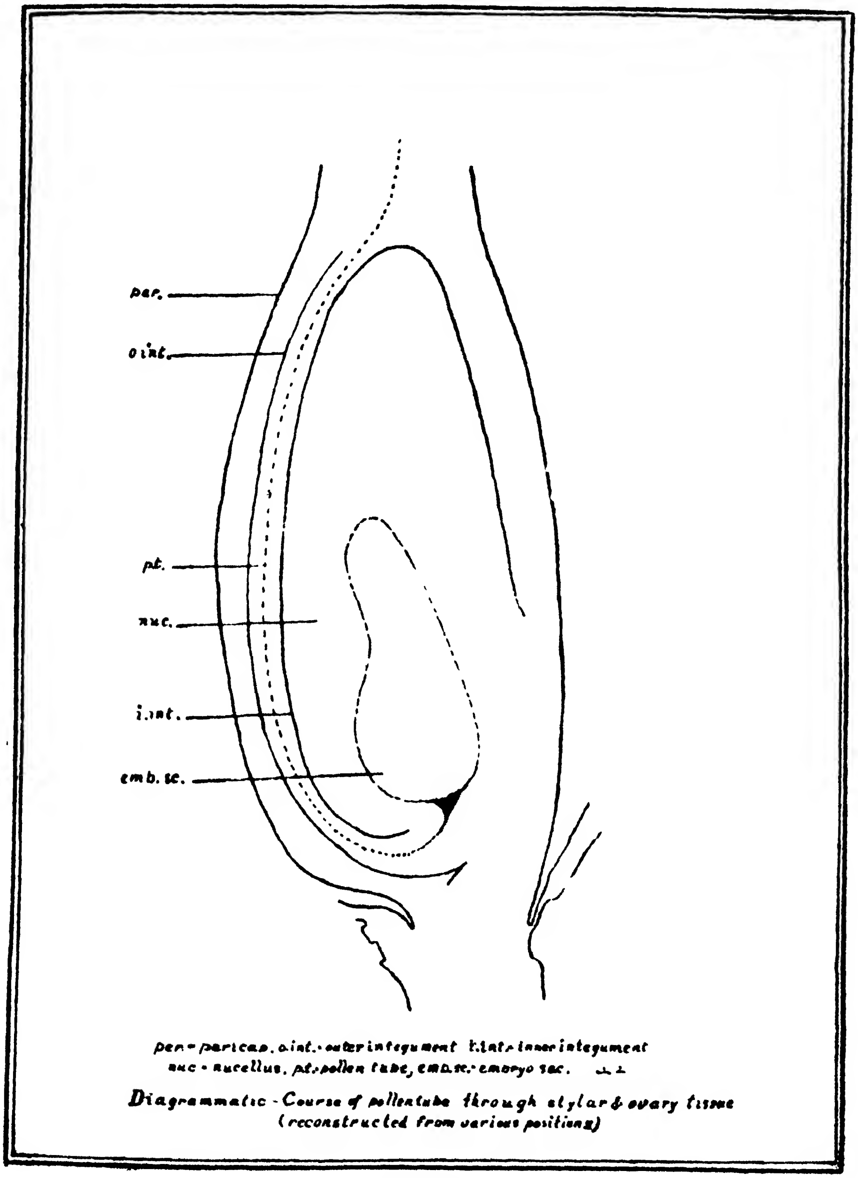

Fig. 2

(*v*) *Seed development.*—After making sure that normal fertilization took place, at any rate, in the arrows developing inside sheds, they were left to mature. Flowers were dissected now and then to see the course of development of the "seed" (Fig. 3). The arrows started drying off nine to fifteen days after the completion of flower-opening and the mature portions which just shattered from their stalks were collected. The mature fluff was dried in muslin bags by hanging the latter in a room kept at 35°-38°C. Drying for eight to twelve hours was found enough after which some of the fluff was sown for germination tests while the rest was preserved in small tins with 5 grms. bits of calcium chloride wrapped up in muslin in each tin. Carbondioxide was then passed in the tins to replace air and the tins were sealed with paraffin. Some fluff was also stored without any preservative to find out the period over which fluff remained viable at Masheri. Setting percentage was found to be high in the case of varieties Co. 285, Co. 326, Co. 346, and P. O. J. 2878, while varieties Co. 313, Co. 323, Co. 325, and Co. 342 showed poor setting. Seasonal variations seemed to influence considerably both the setting percentage and the viability of the seed. During the two years 1932-33 and 1933-34 when winter was severe and rather low temperatures were experienced, the setting percentage in the field was extremely low, while in 1934-35 due to milder winter—free from sudden fluctuations in the daily weather—a very large number of varieties set seeds in the open and the large number of germinations that have resulted this year points to the more vital and viable nature of the seeds. The time taken by arrows to mature after the completion of opening of flowers varied between, fourteen to twenty days in different varieties while the time required from the emergence of an arrow to its maturity was found to vary between thirty-seven to fifty-four days. The arrows emerging late in the season invariably took less time to mature but the seeds were often found to be underdeveloped.

(*vi*) *Viability of seeds.*—Seeds thus obtained were germinated in petri dishes on moist blotting pads at 32°-35°C care being taken to sterilize the petri dishes and blotting sheets before use. Acidified distilled water was found to afford protection against any fungus attack and also to enhance the rate of germination. Germination started on the third day and continued for a week after which no more germinations were observed. The seeds that did not germinate within the first ten days in petri dishes never did so afterwards. Seeds from different varieties differed in their vitality and viability (Table XI).

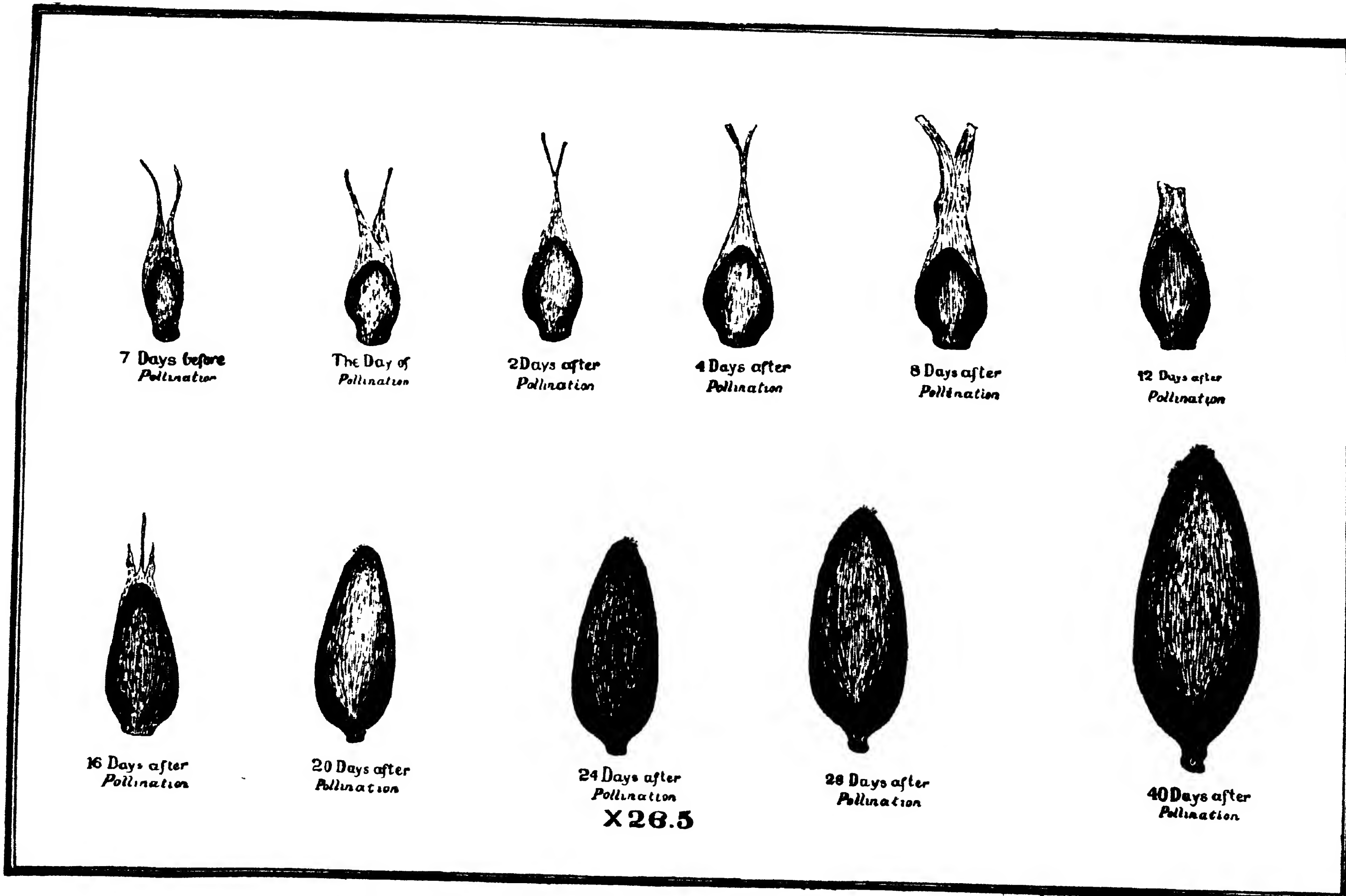

FIG 3 The growth in size of sugarcane "SEED" (Caryopsis).

TABLE XI

Viability of seed as tested in Petri dishes at 32°-35°C*

Variety	Total No. of seeds kept for germination	No. germinated	Per cent germination	Time taken in days for first germination
Co. 205	500	156	31·2	5·0
Co. 285	500	237	47·4	2·2
Co. 312	500	19	3·8	3·4
Co. 313	200	6	3·0	7·0
Co. 325	200	27	13·5	4·0
Co. 326	500	243	48·6	2·0
Co. 346	500	181	36·2	2·8
Co. 356	500	139	27·8	5·0
P. O. J. 2878	500	219	43·8	3·8
Co. 300 × Co. 342	150	23	14·6	5·4
Co. 300 × Co. 326	250	91	36·4	2·8

* Average of 5 tests each lasting for 10 days.

Sugarcane seed is considered to lose viability rapidly if left in the open after being mature. Doty [1928] has reported sugarcane seed to lose viability within a few days. Mangelsdorf [1928], Sartoris [1931], Darragh [1931], and other workers in the tropical countries have expressed similar opinion. Experience at Coimbatore [Venkatraman, 1925; Dutt, 1930] has also been the same though mention is made of a batch of hardy seeds which were sent from Coimbatore to the United States of America, to the Bureau of Plant Industry, having germinated after that journey. At the Sugarcane Research Station, Masheri, fluff which was thoroughly dried and kept in tins without any preservative remained viable for over seven months and lost viability only during the rains when no germinations were obtained although the preserved fluff gave fair number of germinations (Table XII).

TABLE XII

Viability of preserved (in $CaCl_2 + CO_2$) and unpreserved seed

Variety Co. 285

Date on which test was made	Preserved seed Per cent germination obtained	Unpreserved seed Per cent germination obtained
15th February	44·2	38·9
25th March	42·7	39·6
10th May	38·4	30·0
7th June	33·4	26·0
21st July	22·0	4·1
11th August	14·9	No germination obtained
6th September	14·0	,,

The loss of viability of seed during the rains may be attributed to the conditions of high humidity as was found to be the case in Porto Rico by Davis [1929]. Instances of sugarcane seed keeping viable for over two months after being sown were also met with. A few pans were sown with the fluff obtained from the selfed arrows of Co. 326 during the first week of January to see if germinations could be secured in the open. No germinations were obtained for over a month and it was surmized that the seeds had lost viability. With the advent of spring, however, profuse germinations were obtained from the same pans showing that the seeds had kept viable during all this time. The phenomenon might indicate the value of cold storage in preservation of sugarcane seed in tropical countries.

Strong pollinating parents have been found generally to produce seeds that kept viable for a longer period. Seeds obtained from the selfed arrows of the varieties Co. 205, Co. 285 and Co. 326 showed high powers of withstanding adverse conditions without losing viability. It is likely that the longevity of seed in the case of these varieties may have been derived from the wild progenitor—*S. spontaneum*—in which case seeds have been found to keep viable for over two years.

(*vii*) *Raising seedlings* :—Having obtained viable seeds the next problem was to raise large number of seedlings and to grow them to maturity. Shallow seed-pans of the type used at the Imperial Sugarcane Station, Coimbatore, were got made locally. Various admixtures of sand and well-sifted horse-dung were tried in the pans to serve as seed-bed for the newly germinating seedlings. A mixture of two-third gritty sand and one-third finely powdered dung was found

to be the best medium for the purpose. While satisfactory germinations could also be obtained in a mixture of Gandak sand and farmyard manure, the subsequent growth of seedlings in such a mixture was very much restricted due possibly to packing hard of the fine sand particles. Loose and properly moist texture of the medium during the early stages appeared to be one of the essential factors in the successful raising of seedlings. Fluff was sown uniformly over the whole seed-bed surface and immediately watered. To ensure proper moisture conditions for germination, covering the fluff after sowing for three to five days with thick linen cut to the size of the mouth of the pan was found very useful. Owing to the prevalence of low atmospheric temperatures during the months of December and January, the sown seed-pans were kept in a room at 32°-35°C, this temperature having been found to be the best for germination in petri dishes. On sunny days the seed-pans were removed to the open for three hours at noon, and this exposure to sunshine was found to result in healthier growth. Irrigation with 0·1 per cent solution of Niciphos II (P_2O_5, 18 per cent, N, 18 per cent) when the seedlings had developed three to four leaves appeared highly conducive to vigorous growth. In this way a large number of seedlings from selfed and crossed arrows were successfully raised during the winter months by affording the temperatures noted above. After January a wider range of temperature from 28°-38°C could be allowed without prejudicially affecting either the germination or the subsequent growth. These temperatures were easily maintained by means of paraffin heating stoves regulated by an intelligent attendant An elaborate glass-house with heating arrangements therefore does not seem to be a necessary pre-requisite to this work. Seeds were sown at intervals of ten days from January onwards till March to find out the best time for sowing seed under Bihar conditions. The results showed that earlier these seedlings were sown, the better their vigour and growth. Not only were they firmly established by the time the hot westerly winds (which are so common in these parts during spring and early summer) began to blow but they also matured about the same time as the main crop, thus enabling their comparative merits to be easily judged. Seedlings raised in March suffered heavy mortality in spite of the protection afforded by thatched sheds. Earlier sowing under controlled conditions would thus appear to be a distinct advantage.

Further work has shown that special-sized pans are not essential and that seedlings can be satisfactorily raised in properly prepared seed-beds. These are small plots of any convenient size which are filled upto a height of three inches with the same medium as is used in the seed-pans. A ditch 3-in. wide and 6-in. deep runs round the beds and serves for irrigation and drainage. The fluff is evenly spread in the bed and is covered over with thick linen which is kept continuously moist for the first few days. Though germination in the beds is slightly delayed, the subsequent growth is very rapid. It has been found that the seedlings raised in seed-beds suffer little mortality and stand transplanting better

owing to the development of stronger nodal roots. The 'pricking'* which has to be carefully attended to in the case of seed-pans seems scarcely necessary in the case of seedlings in the seed-beds. When the seedlings are six to nine inches high they are transplanted 12 in. apart in long and narrow beds provided with sandveins [Venkatraman, 1928, 1] to permit of proper drainage. Irrigation for the first few days is done by means of a shower spray after which bi-weekly irrigations from a small hand-pump are resorted to. Seedlings stay in these beds till the break of monsoon when they are again transplanted in ordinary well-prepared beds on highland. Manuring at the rate of 40 lbs. N + 50 lbs. P_2O_5 per acre applied in two equal doses, half at first earthing in July and the remaining half at second earthing in August is given. Except necessary weeding and hoeing between the showers nothing more is done till the cold weather when seedlings are examined for their habit and vigour. The agriculturally sound ones are then analysed for sugar and seedlings selected for further trial along with the standards. Seedlings are found to attain maturity within fourteen months of their germination.

* Process of removing seedlings out of crowded seed-pans into another set of prepared ones to avoid competition and to provide more favourable conditions of growth.

IV. Discussion

The results presented above demonstrate the possibilities of breeding new varieties of sugarcane in Bihar. Any economic success must depend upon whether or not the varieties which it is desired to cross flower regularly under local conditions; whether they flower simultaneously, and at the right time; whether the flowers are fertile and whether conditions for normal development of seed and raising of seedlings obtain. The observations of the past three seasons show that many Coimbatore varieties, certain of the exotic canes and several wild saccharums flower to a varying degree (Table XIII) and fairly simultaneously.

Table XIII

Flowering behaviour of different varieties of sugarcane in Bihar

Varieties	Nature of flowering	Period over which varieties flower
Co. 205	Profuse .	September to March
Co. 210	Sparse .	February to March
Co. 213	Medium .	January to February
Co. 214	Sparse .	March to April
Co. 281	Medium .	October to December
Co. 285	Profuse .	September to February
Co. 290	Medium .	November to January

Varieties	Nature of flowering	Period over which varieties flower
Co. 299	Profuse	November to January
Co. 300	Sparse	December
Co. 301	Sparse	January
Co. 312	Medium	December to January
Co. 313	Profuse	December to January
Co. 318	Medium	October to January
Co. 320	Rare	..
Co. 326	Profuse	October to February
Co. 330	Sparse	January
Co. 331	Medium	December to January and in March
Co. 336	..	..
Co. 342	Medium	December to January
Co. 343	Medium	January to February
Co. 346	Profuse	October to December
Co. 349	Medium	November to December
Co. 353	Sparse	December
Co. 356	Profuse	December to February
Co. 360	Sparse	November to December
Co. 408	Medium	January to February
P. O. J. 2878	Profuse	November to January
P. O. J. 213	Sparse	December
B. 6308	Sparse	January
Khelia	Sparse	February to March
WILD FORMS		
Sac. munja	Profuse	August to October
Sac. spont. (local)	Profuse	August to November
Sac. robustum	Sparse	December to February
Sac. spont. (Burma)	Medium	September, November and February.
Sac. gigas	Sparse	February to March

NOTE.—Recently more valuable breeding material has been received through the kindness of the Imperial Sugarcane Expert, Coimbatore.

And although the fertility of flowers and the seed setting are often erratic under field conditions, uniformly good results have been obtained under conditions of controlled temperature and humidity. Seedlings have been successfully raised during the months of December and January and this early start has been found to contribute to vigorous growth so that the seedlings so raised have come to maturity about the same time as the cultivated types which are usually planted in February and March. The wide range in the period over which different varieties keep on flowering, seems a definite advantage in so far as it affords, opportunities of making large number of combinations. It has, however, been noticed that

the late formed arrows do not give very viable pollen and that the setting is poor, seeds being at times shrivelled and under-developed. Attempts have therefore been made to so time planting [Venkatraman, 1917 ; 1928, 2 ; 1929] and give such treatments as are conducive to arrowing in the months of November and December during which time the fertility of flowers has been found to be at its best. Planting desirable parents under different soil conditions particularly those of heavy lowland liable to waterlogging and of high pH, and injecting into plant body at different stages of its growth certain chemicals such as mercuric chloride and ferrous sulphate in doses of varying concentrations have enabled the breeding work to be started as early as mid-October. *S. spontaneum* (Burma) which is reported to be rather recalcitrant in the matter of flowering at Coimbatore and elsewhere, has with certain of the injection treatments flowered profusely. The subject of hastening flowering in canes, however, will be discussed in detail in a separate paper. Suffice it to say, that no paucity of material has been experienced for the past three seasons for carrying on such work, and the number of seedlings raised (Table XIV) has steadily increased.

Table XIV

Sugarcane seedling in Bihar

Year	Total No. of seedlings raised	No. grown to maturity	No. selected and grown in second year	Remarks
1932-33	23,600	9,600	270	This being the first year no economic crosses were made.
1933-34	27,215	3,028	239	A large number of seedlings succumbed due to the lands at the station having been heavily sanded up and the tube-well having collapsed.
1934-35	Over 60,000 in beds	..	..	With the provision of irrigation facilities it is hoped that it will be possible to grow some tens of thousands to maturity. Five of the promising seedlings out of the 1932-33 lot have been sent out for trial this year at three of the central farms in the province.

Increased setting in the open in a number of varieties this year has further strengthened the belief that conditions in Bihar are not very unfavourable for breeding work.

Controlled conditions of temperature and humidity are in the nature of safeguards against sudden fluctuation of daily weather which have been found to affect profoundly the fertility of flowers. The portions of arrows which opened during the period of abnormal weather did not produce any viable seed. Also the effect of such adverse conditions lasted for some days (Table XV). The viability of the seeds recovered from portions of the arrows that opened subsequent to the low temperature period was also found to have been seriously affected.

TABLE XV

Effect of sudden fluctuations in minimum temperature on the fertility of flowers—Variety—Co. 346

Period of observation	Minimum temperature	Pollen viability	Stigma receptivity
	°F	Germination in sugar media per cent	Germination of foreign pollen on stigmatic surface per cent
27th December 1933	46·8	40·2	29·7
28th December 1933	39·0	28·4	23·2
29th December 1933	33·4	10·9	16·3
30th December 1933	38·6	8·7	14·9
31st December 1933	43·2	9·1	14·2
1st January 1934	42·9	14·4	15·7
2nd January 1934	41·1	18·9	22·5
3rd January 1934	44·4	31·1	21·8
5th January 1934	46·2	37·9	24·4

It may be stressed that the low temperatures prevailing in Bihar are not so much responsible for poor results as are the sudden variations of temperature between the day maximum and the night minimum. Successful setting was obtained in unprotected arrows during the normal weather at temperatures below 48°F. It may be of interest to note that sudden low temperatures were found to affect more prejudicially the viability of pollen while low humidities told more adversely on the receptivity of stigma.

Irrigating the rooted stalks every evening with warm water was found beneficial in two ways. Firstly, it helped to maintain the soil and plant temperatures which did not suffer the same fall as did soil and plants not so treated (Table XVI) and secondly, it accelerated the rate of root intake. During the winter months

the activities of sugarcane roots are at a minimum [Khanna, 1934] and the treatment mentioned above made it possible for the arrows to be fed with the necessary chemicals and nutrients. The development of the seed under such conditions was found to be quite satisfactory.

TABLE XVI

Effect of warm water irrigation on soil and sap temperature*

Description	Temperature °F	
	Soil	Sap
Untreated	54·9	60·1
Treated	61·4	68·2

* The thermocouple junctions used for determining plant temperatures were kindly got made for me by the Agricultural Meteorologist, Poona, to whom thanks are due.

Sugarcane seed thoroughly dried has been found to keep viable for over seven months. This observation is at variance with the experience at Coimbatore and elsewhere and is very likely due to the prevalence of low temperatures which tend to harden the pericarp and introduce certain amount of dormancy [Munerati, 1920]. This view is corroborated by comparatively delayed germination obtained from seeds exposed to low temperatures (Table XVII), and explains why seeds sown in pans and kept in the open during January fail to germinate although they remain quite viable and give satisfactory though delayed germination when favourable conditions of temperature are restored.

TABLE XVII

Germination of sugarcane seeds exposed to low temperatures (28°F.-38°F.)

Treatments	No. of tests	No. of seeds kept for each test	Germination per cent No. of days after sowing					
			3	4	5	6	7	10
Exposed to low temperatures 28°F.-38°F .	5	100	..	2·2	5·8	2·8	27·2	39·7
Not exposed . .	5	100	5·4	12·6	24·2	36·0	41·6	41·8

This longer viability would appear to introduce greater certainty in the matter of successful raising of seedlings and to afford better chances for sowings to be made at times most suited to different stations.

V. Summary

The possibilities of breeding sugarcane varieties under Bihar conditions have been for the first time demonstrated. Although the fertility of flowers and seed-setting have been erratic under field conditions, uniformly good results have been obtained under conditions of controlled temperature and humidity. Large number of seedlings from different selfs and crosses have been raised to maturity during the past three seasons and the first batch of five seedlings has been sent out this year for trial at three of the central farms in the province. The wide range in the period over which different varieties flowered—quite a number of them arrowing fairly simultaneously—and the longer viability of the seeds produced would appear to be distinct advantages. Other interesting points brought out during the course of study were as mentioned below :—

(*i*) The time of flower-opening in Bihar varied between 8-5 A.M. in November to 10-0 A.M. towards the end of December.

(*ii*) On frosty days though flower-opening proceeded fairly normally, pollen-shedding was invariably delayed and took place only late in the afternoon. Low temperatures appeared to restrict both the normal development of anthers and their dehiscence. Varieties Co. 281 and Co. 331 which had preponderance of closed and shrivelled anthers in December and were considered good females showed high percentage of open anthers in February and March when the former was successfully employed as male parent.

(*iii*) Viability of pollen was found to differ in different varieties, heavy pollen-shedding ones usually showing quicker rate of pollen-tube growth. It also varied in a season and in different localities. Prevalence of low temperatures and frost adversely affected the pollen viability.

(*iv*) Stigmas were found to be more receptive under controlled conditions than in the open. Humidities between 65-75 per cent saturation were found conducive to stigma holding more pollen and to larger number of pollen germinations.

(*v*) Fertilization under Bihar conditions was found to take between ten to twelve hours after pollination.

(*vi*) Sugarcane seeds thoroughly dried and kept without any preservative remained viable for over seven months and they lost viability only during the rains. Instances of sugarcane seed keeping viable for over two months after being sown in the open were also observed.

Seeds from different varieties and combinations differed in their vitality and viability. There was an indication that the stronger pollinating parents produced seeds that kept viable for longer periods.

(*vii*) For germination of sugarcane seeds in Petri dishes acidified distilled water was found to afford protection against fungus attacks. It also enhanced the rate of germination.

(*viii*) Loose and properly moist texture of the seed-bed during early stages of seedling growth appeared to be one of the essential factors in the successful raising of seedlings and a mixture of two-third gritty sand and one-third finely powdered dung was found to be the most suitable medium. Covering the fluff with thick linen kept moist was found advantageous during the first few days after sowing.

(*ix*) Irrigation with 0·1 per cent solution of Niciphos II (P_2O_5 18 per cent, N 18 per cent), when seedlings had developed the first three to four leaves proved highly conducive to vigorous growth. To get seedlings ripened about the same time as the main crop, earlier sowings under controlled conditions were found decidedly better than sowings in open in February.

(*x*) Sowing in nursery beds instead of pans was found to greatly reduce the mortality of seedlings which stood transplanting better. This was found to be due to the development of stronger nodal roots in the former case.

VI. Acknowledgment

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SELECTED ARTICLES

WEIGHT OF CALVES AND PERIOD OF GESTATION IN SOME INDIAN BREEDS OF CATTLE

BY

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(Reprinted from *The Madras Agricultural Journal, Vol. XXIV, No. 6, June 1936.*)

Weight of calves.—In the Live-stock Section of the Madras Agricultural Department, the calves born in the different herds are weighed at birth and the present note is the result of the analysis of the records of the weights of calves at birth for the past 11 years in the herds of (1) Kangayam, (2) Sind and (3) Ongole.

Sex and weight of calf.—In all the above three herds, it is found that the weight of calf is significantly higher for the bull calf than for the heifer calf. Table 1 summarises the results obtained both by the method of comparison of the means for the two sexes with their respective standard errors and also by the method of $2 \times n$ classification (Fisher's).

TABLE I

Sex and weight of calf

Mean weights of calf			Alternative method		
Breed	Bull	Heifer	Deviation S. E. D.	χ^2	$p=0 \cdot 05$
Kangayam .	$44 \cdot 6 \pm \cdot 41$	$41 \cdot 4 \pm \cdot 35$	5·87	52·5	28·869
Ongole . .	$62 \cdot 0 \pm \cdot 67$	$57 \cdot 7 \pm \cdot 53$	5·00	57·9	30·144
Sind . .	$44 \cdot 9 \pm \cdot 47$	$41 \cdot 7 \pm \cdot 52$	4·57	27·1	26·296

The increase in the mean weight of bull calf over the heifer is significant, indicating that sex has an influence.

In addition to the above general indication, it is seen from Table I that in the Ongole herd, the average weights of calves in both the sexes are considerably higher than in the other two breeds, Kangayam and Sind.

It is quite probable that it may be the characteristic of the Ongole breed that the calves at birth are well developed, but the figures in Table II showing the weight of calves at birth in the same breed born for the same bulls, but from cows bred in different stations as Chintaladevi and Hosur, show clearly the influence of locality.

TABLE II

Bull No.	Chintaladevi				Hosur			
	Bull calves No.	Heifer calves No.	Average weight		Bull calves No.	Heifer calves No.	Average weight.	
			Bull calf	Heifer calf			Bull calf	Heifer calf
			lb.	lb.			lb.	lb.
6	18	25	69·3	60	12	9	50	46
14	3	1	66·0	62	20	8	62	54
31	3	5	58·3	58	13	16	60	53

As regards the management of the stock in both places, the feeding of the stock was similar for concentrated rations but for forage, the Chintaladevi stock received *cholam* straw grown on the farm and the Hosur received spear grass hay. The analysis of soils in both the places (Table III-*a* and III-*b*) show that the lime content of Hosur soil is definitely poor when compared with Chintaladevi soil.

Hosur Live-stock Research Station

TABLE III-*a*

Composition of soils of paddocks from which samples were drawn

—	Paddock No.			
	3	35	32	38
Lime as CaO	0·14	0·28	0·28	0·11
Total potash	0·23	0·45	0·31	0·15
Available potash	0·024	0·010	0·020	0·013
Total phosphoric acid . . .	0·05	0·05	0·04	0·04
Available phosphoric acid . .	0·0016	0·0019	0·0045	0·0086
Nitrogen	0·042	0·072	0·074	0·057

Generally the four paddocks were poor in lime and phosphate ; Nos. 3 and 38 in nitrogen in addition.

Chintaladevi Live-stock Research Station.—The following are the results of analyses of four soil samples from the Live-stock Research Station, Chintaladevi, 1924 :—

TABLE III-*b*

—	Black soil		Red soil	
Loss on ignition	4·45	6·42	6·40	3·97
Insoluble mineral matter	81·60	75·26	67·79	81·47
Iron oxide (FeO_3)	3·81	4·57	5·87	4·74
Alumina (Al_2O_3)	4·02	8·41	11·45	7·80
Lime (CaO)	3·29	2·50	4·18	0·44
Magnesia (MgO)	0·53	0·41	0·21	0·43
Phosphoric acid (P_2O_5)	0·029	0·025	0·025	0·019
Potash (K_2O)	0·22	0·29	0·73	0·49
Soda (Na_2O)	0·51	0·38	0·37	0·46
Sulphuric acid (SO_3)	0·12	0·067	0·076	0·074
Carbonic acid (CO_2)	2·38	2·26	3·00	Trace
Nitrogen (N)	0·023	0·027	0·033	0·038
Available phosphoric acid (P_2O_5)	0·0054	0·0066	0·0005	0·0014
Available potash (K_2O)	0·0059	0·0069	0·0029	0·009

The following are the details regarding the sex and weight of calf in the different herds.

Kangayam herd.—531 calves have been born to 16 different bulls, of which 274 were heifers and 257 bull calves. The average weight of these calves works out to 45·2 lb. for a bull and 41·7 lb. for a heifer, the highest weight being 62 lb. both for a bull and heifer calf and the lowest weight 25 lb. for a bull and 21 lb. for a heifer calf.

One bull produced 47 calves, the average weight of the calves being bulls 49·6 lb. and heifers 45½ lb. Some bulls produced more heifer calves than bull calves and *vice versa* ; bull No. 35 has 43 bulls and 73 heifer calves to his credit whereas No. 132 has 25 bulls and 11 heifers.

Sind herd.—15 different bulls have produced 277 calves of which 140 are heifers and 137 bull calves. The average weights of these are bulls 45 lb., heifers 41·5 lb. The highest weight for a bull calf is 66 lb. and for a heifer 56 lb., the lowest weights being bull 26 lb. and heifers 27 lb.

Bull No. 118 produced 24 calves, the average weights being bulls 51 lb. and heifers 43 lb.

Bull No. 8 has produced 18 heifer calves and 6 bull calves and No. 38 has 11 heifers and 4 bull calves to his credit whereas bull No. 115 has produced 15 bull and 7 heifer calves.

Ongole herd.—*Chintaladevi Farm.*—248 calves were born to 9 bulls of which 120 were bull and 128 heifer calves. The average weight works out to 65 lb.

for bull calves and 59·5 lb. for heifer calves. The highest weight for a bull calf is 83 lb. and for a heifer 84 lb., the lowest being bull calf 34 lb. and heifer calf 38 lb.

Bull No. 8 has produced 72 calves, 40 of which are heifers and bull No. 125 produced 37 calves, 21 of which are bulls and 16 heifers.

Forty-three calves were born to bull No. 6. 18 bull calves averaged 69·3 lb. each and 25 heifer calves 60 lb. each.

Hosur Farm.—Ten Ongole bulls produced 199 calves of which 109 were bull and 90 heifer calves. The average weight works out to bulls 60·3 lb. and heifers 54 lb., the highest weights recorded being bull calf 80 lb., heifer calf 84 lb.

Bull No. 14 produced 28 calves, 20 of which are bull and 8 heifer calves.

Twenty calves were born to one bull, of which 11 bull calves averaged 63 lb. and 9 heifers 59·5 lb. each.

Period of gestation in cows.—Breeders generally accept the average period of gestation of cows as 285 days ; if a cow goes longer than this, their opinion is that the calf will most probably be a bull calf. The writer has gone through his records and worked out the average period of gestation in cows of the Ongole, Kangayam and Sind breeds. The breeders' acceptance of 285 days gestation period holds good for most cows of the Kangayam and Sind breeds, but not for the Ongoles. For some unknown reason the period of gestation for Ongole cows is 3 to 4 days longer on the average than the two former breeds.

There were cases in all the 3 breeds where some cows calved earlier than 277 days and some over the 300 days periods but these have been omitted.

TABLE IV

Sex and period of gestation

Mean period of gestation			Alternative method		
Breed	Bull	Heifer	Deviation S. E. D.	χ^2	$P=0\cdot05$
Kangayam	$286\cdot6\pm\cdot30$	$284\cdot1\pm\cdot26$	6·65	57·33	35·172
Ongole	$289\cdot8\pm\cdot32$	$288\cdot5\pm\cdot30$	2·80	33·46	36·415
Sind	$286\cdot3\pm\cdot41$	$284\cdot5\pm\cdot38$	3·00	36·17	35·172

Table IV shows, for the Ongole, in the period of gestation for cows (*a*) a significant increase in both the heifer and bull calves born, (*b*) sex of calf has also a significant relationship with the period of gestation.

I wish to thank Mr. K. Ramiah, Paddy Specialist, for his kind assistance in working out the results statistically.

RECENT WORK IN PLANT BREEDING

BY

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For some eight thousand years man has been engaged in the breeding of plants for his own use, and during these long centuries of time there has been a steady improvement of all the plants which provide him with material for food, clothing and ornament. Up to thirty-five years ago this improvement was for the most part haphazard and accidental; though in fact intelligent selection of the best and most useful varieties was constantly practised, and any new improvements unexpectedly arising were carefully preserved. Actually the progress achieved by these non-scientific but commonsense methods was extraordinarily good, but owing to a lack of knowledge of the laws of heredity it was of necessity extremely slow and often wasteful in effort and outlay.

In 1900 the finding of Mendel's long-lost paper disclosing his discovery of the fundamental laws of heredity caused a complete revolution in breeding. To their credit plant-breeders were quick to grasp the importance of the new facts in helping them to a more speedy and a surer solution of their problems. In all cultivated plants new work was enthusiastically carried through, old varieties were tested and purified and new varieties were raised which contained a preponderance of desirable qualities. The further discovery that all heritable characters, whether structural or functional were due to the actions and reactions of the minute living molecules known as genes, situated in the chromosome threads of the nucleus of each cell in every plant and animal (including man), was a still greater cause of progress. It was immediately realized that the best results in breeding could only be obtained by an intensive study of the chromosomes and genes of any plant which was being used. This study revealed many startling facts, and provided a complete explanation of some hitherto quite inexplicable difficulties. It is safe to say that the union of the two new sciences of Cytology and Genetics into one was one of the greatest revolutions ever brought about in biological science and is bound to have the greatest possible influence on the future of man.

After thirty years of concentrated experiments by a great number of research workers with millions of plants and animals in the numerous laboratories and research stations which had sprung up all over the world, it was realized that in many cases the limit of improvement had been reached. The

existing varieties had been bred to such an extent that their possibilities were more or less exhausted, their desirable genes had all been utilized and all the most desirable combinations had already been attained, though in many cases the ideal had not been fulfilled. Only one thing could give further progress—the introduction of new genes and new methods of combining them with the old genes.

The discovery that new mutations could be produced by X-raying gave a new stimulus to the work. Unfortunately as in all natural mutations, the great majority of X-ray mutations are pathological or lethal, so that although their incidence is enormously increased the production of new forms of real value by this means involves considerable labour in testing large progenies. Fortunately a new and extremely profitable method arose in the hybridization of widely distinct species and even genera which, by their combination, brought together entirely new gene-complexes of a highly desirable kind. Hitherto the union of different species had brought about little success owing to the sterility of the hybrids. The discovery that a duplication of the entire chromosome set of the hybrid either in the germ cells or in the body cells [Hurst, 1933, 1935] produced fertile germ-cells and progeny and created new species and genera, gave new hope to this branch of breeding which has proved to be amply justified. In this connection the use of X-rays is of great value, for one of the most useful results of this treatment is the duplication of chromosome sets. In an ordinary species this is important, although not of vital importance, since it only increases the size of the individual without producing any other desirable genic changes, but in these specific or generic hybrids it is of the utmost value, for it converts a sterile hybrid into a fertile and pure-breeding new species or genus combining the qualities of the two parent species, and containing a new complex of genes which often in their reactions together give rise to new qualities. Above all the new forms possess greater potentialities for mutation in the greater number of genes, and hence afford more hope for the production of new varieties.

Here we come to the real essence of modern plant-breeding. Once the possibilities of interspecific and intergeneric breeding were realized, the introduction of new genes became an all-absorbing problem. The great work of the modern breeder is the search for new genes, especially those which give resistance to the numerous and devastating diseases which attack crops in every country. Fortunately, it has been discovered that in most genera there are many wild-growing species which are immune to the diseases which attack cultivated plants, and by using these species it is hoped to be able to produce disease-resistant plants which will still contain all the desirable points of our best cultivated varieties together with the addition of other good characters which are not yet present.

Under their able leader Dr. N. I. Vavilov, the Russian plant-breeders have been in the forefront of this new phase of breeding. Expeditions have been sent out to every country in the world to collect all the possible species allied to the plants which constitute our present crops, and also to discover new sources of the

various commercial commodities, such as fibres, oils, rubber, etc. In addition to the wild-growing species there are many ancient species and varieties still in cultivation in remote and outlying districts which contain valuable qualities, especially in their adaptation to peculiar and exacting environments. One of the great problems of modern plant-breeding, besides that of disease resistance, is the production of varieties which will give a full yield under adverse conditions. In a country such as Russia, and within our own Empire (under such diverse conditions as exist in Australia or Canada), there is a great need for new varieties and new types of crops fitted to each particular type of locality. It is useless to expect a high-yielding, disease-resistant plant fitted to normal conditions to function adequately in districts subject to drought or to extreme cold ; such districts must have their own varieties specially bred for them For this purpose the old-type crops of the isolated communities are ideal, for they have, through countless generations of natural selection, become adapted to their environment, which in many cases is of a highly specialized character, since they are usually found in out-of-the-way mountain districts or under steppe or desert conditions. In these districts there is a weatlh of new genes to be found in every kind of cultivated plant fitted to all possible conditions.

The experimental stations throughout the world are making exhaustive collections of the likely wild-growing species and of the locally cultivated crops, and from the new gene combinations arising from their hybridization with our existing crops great hopes are entertained.

Cotton.—In cottons work has been proceeding steadily all over the world. In attempts to produce cottons suitable for their diverse environmental conditions the Russians have put in an immense amount of work in studying the genes and chromosomes of varieties and species, and have carried through numbers of hybridizations. At Tashkent, a study was made of ginning percentages by investigating the number and weight of the fibres and weight of seed, and it was found that there was a wide deviation in this respect between different cottons. The number of fibres per seed in seven varieties of American cotton varied from 7·8 to 14·7 thousand, while the weight of a thousand fibres varied from 4·4 mg. to 7·6 mg., and the seed weight from 97·0 to 167·2 mg. In *G. herbaceum* the number of fibres per seed varied from 3·6 to 9·2 thousand, the weight of a thousand fibres from 3·4 mg. to 5·8 mg., and the seed weight from 69·7 to 111·8 mg. Crosses have been made in which it is hoped to combine the higher number of fibres with the heavier weight, and in the second generation of a cross between two lines of *G. herbaceum* some plants arose with the desired combination and showed a ginning percentage of from 7 to 13 per cent higher than the better parent. In the fourth generation a true breeding line was obtained in which the percentage was 8 per cent higher than the better parent.

The type of boll in *G. herbaceum* is very variable, but the closed boll proved to be a simple mendelian recessive to the open or semi-open boll, both of which are

undesirable in mechanical harvesting. Size of boll was found to be dependent on a number of genes in American cottons, and it was necessary to grow some thousands of F_2 seedlings to obtain the desired types. By crossing with early maturing forms it was also found possible to unite high yield with early maturity. Many other points were studied, and it is pointed out that since a large number of genes are involved in these cottons it is wiser to limit the parental combinations as much as possible in producing new varieties by hybridization, and to grow the largest possible number of progeny. Back-crossing is also useful for reducing the number of segregating types in later generations.

The Transcaucasian Cotton Research Institute have issued a bulletin describing the progress made in the acclimatization of Egyptian cottons ; descriptions, illustrations and lint qualities of selected new lines are given. The varieties have been divided into six groups based on their maturity periods. Another publication from Moscow gives the spinning qualities of a number of the best improved varieties grown in the U. S. S. R. Varieties of the Pima type of Lower Egyptian cottons have been grown under varying conditions for comparison. Upper Egyptian types, including Ashmouni and allied varieties, Uplands and strains with medium staple, have also been tested. It has been found that by means of transplantation it is possible to grow high-quality Egyptian varieties in the region of Tashkent, and some selections of Pima can be spun to 120 counts. Longstapled Uplands, however, are superior in yield, and are as good as the Egyptians for spinning 50's and 60's.

The experiments in vernalization of cotton were attended with much success, not only in producing a higher yield under normal conditions, but also, in several cases, in increasing lint length. The seed is moistened and then kept at a temperature of 25° to 30° C. for varying periods. It was found that the best results were obtained after ten to fifteen days' treatment for Navrotskii, fifteen to twenty days for Acala 8517, and fifteen days for the Egyptians ; longer periods caused depression of germination and shorter periods had no effect. The chief effect of optimum treatment seems to be a more rapid completion of the various phases of development rather than any particular acceleration of their inception. All the varieties vernalized germinated from two to three days earlier than the controls, but later stages showed considerable variation. In the American cottons treatment produced a tendency to higher ginning percentage and length of lint, but in the Egyptians the ginning percentage was increased while the lint length was slightly decreased. The flowering period was usually from three to four days earlier, but in Navrotskii it was as much as thirteen days, and in Ashmouni nine. The differences in maturity were often greater, varying from four to fifteen days earlier. In all cases the plants treated in the Russian experiments showed an improvement over the controls, and it is probable that this method may be of much value in growing crops in those regions not naturally fitted for them. Certain cases of failure are attributed to imperfection of technique rather than to any deficiency in

the treatment, and different varieties gave widely different reactions ; in some cases there were even differences within the varieties themselves. It is pointed out that greater knowledge is needed before the best results can be expected. The effect of the treatment was considerably greater in 1933 (which was a very bad season for cotton-growing in the new regions) than in 1934, when the natural conditions were more favourable to normal growth. Vernalized sowings were made on a large scale on collective farms in 1932, 1933 and 1934, with an increase from 600 ha.* to 3,000 ha. under cultivation in the three years. The average yield increase was from 0·3 to 2·5 centner** per ha. but on one farm the yield increase in the treated crops was four times that of the untreated.

At Tashkent experiments were also made on the photoperiodism (adaptation to length of light-day) of the cotton plant, subjecting different varieties to daily illumination amounting to 6, 9 and 12 hours against the average of 14 hours of the controls growing under normal conditions. Observations showed that cotton is essentially a short-day plant, which complicates its successful growth in long-day regions, since a reduction of illumination causes early maturity. Different varieties, however, show different hereditary reactions corresponding to the position of their original environment with regard to the equator, those from equatorial regions needing the least light and this effect becoming less and less as their place of origin is further removed from the equator. The general effect of the shortened illumination is the production of sympodial branches at a lower level and consequently an earlier production of flowers and bolls. By making the necessary comparative alterations in the daily amount of light it is possible to synchronize the flowering periods of widely divergent varieties and species, and to make crosses hitherto difficult owing to the difference of their flowering seasons in these new regions. Crosses have thus been made between Egyptian cottons with low boll weight and several South American cottons with very large bolls but of short day and perennial habit.

Within our own Empire, work on the improvement of cottons is also steadily proceeding, but this is too well known here to need repetition.

Beans.—New varieties of Soya beans have been produced, suitable for conditions on the Ukraine steppes. Those previously grown proved unsuitable for mechanical harvesting owing to the pods occurring too low down on the plants. Of the new strains produced one is equal in yield to the best imported types and is early maturing, while another provides superior fodder. In Uruguay, where the varieties successful elsewhere have proved failures, a collection of 233 varieties from widely different sources and conditions has provided ten promising types. Selected lines of these have given very high yields, and others have been bred which are resistant to drought, which normally has a very adverse effect on germinating qualities, both at harvest and sowing. The best of these new lines

* Hectare = 2·47 acres. **Approximately 1 cwt.

have a protein content of 34 to 39 per cent and oil content of 14 to 20·5 per cent with a yield up to 1,000 kg. per ha.

This wonder plant, the "staff of life" in the Orient, which provides meal, oil, food for cattle and a fertilizer, has also been successfully introduced into England by careful selection of early maturing varieties and their acclimatization for several years by Mr. J. L. North. The remarkable properties of the Soya bean are not yet appreciated by the British farmer, and a book on the subject has recently been written by Miss E. Bowdidge to make its cultivation more popular. It is to be hoped that its value may soon be realized and taken advantage of by its widespread cultivation.

Cereals.—Work steadily proceeds all over the world to produce new improved forms capable of cultivation under diverse conditions, and to provide each district with an ideal variety by hybridizing the highly specialized local cultivated forms and species with the high yielding normal types. The new genera formed by generic crosses between wheat and rye, and wheat and *Aegilops* in Russia and Germany have already been described in this Review (Hurst, 1932), but recently an even more interesting line of investigation has been opened up in the hybridization of wheats with the couch-grass *Agropyrum*. This grass is perennial and it is hoped thus to produce perennial wheats of extreme hardiness for cultivation under adverse conditions. Three species of *Agropyrum* have been successfully used in crosses at Saratov. The first-generation plants are very luxuriant, forming up to 150 heads on one plant. They show a preponderance of *Agropyrum* characters, which is to be expected since *Agropyrum* is a decaploid with 70 chromosomes (10 sets) while *Triticum vulgare* is a hexaploid with 42 chromosomes (6 sets). The hybrids were all perennial and fully resistant to frost, and the first generation of *T. vulgare* crossed with *A. elongatum* is distinguished by excellent fertility, one plant giving as many as 665 grains. Other crosses showed diminishing fertility according to the parentage. In the second generation wide segregation occurred, but the fertility was higher, the grains being large and vitreous. In the third generation many plants showed quite normal fertility, grain being mainly of the wheat type. Several of the hybrids showed resistance to rust and smut, and freedom from shattering, with the addition of various other valuable characters, and this new breeding work is obviously of great practical importance. It is evident from the results obtained that certain species of couch-grass have a very close affinity with certain wheat species, their distinction apparently lying only in their two extra chromosome sets. Thus *T. vulgare* may be designated A + B + C and *Agropyrum* A + B + C + X + Y, other species of both having variations. Hence it should not be difficult to fix desirable types in future generations, and it is also probable that some fortunate duplications may occur to hasten the process.

The new genus *Secalotriticum* (Rye × Wheat) (or *Triticale*) is already grown on a large scale. The most notable achievement of the Russian grain-breeders,

however, is probably the distribution of a very large number of improved varieties of the chief grain crops (wheat, barley, oats and rye) especially suited for cultivation in all the main regions of the Soviet Union, including the arid zones. This has been achieved in the north by the production of ultra-early spring wheats and new hardy winter varieties. One of the new early oats is also highly resistant to drought and rust. The hybrid *Avena sativa* × *A. byzantina* exceeded the standard yield by four times and showed considerable resistance to leaf-rust, and a new rye produced by crossing a local form of Detskoje Selo with Rumker also showed a great increase. Further improvements are still required, however, especially in disease resistance. From a close study of the methods used it may be seen that all the desirable new qualities have been introduced by using local varieties in crossing, since they possess the essential genes for resistance which are needed by the existent varieties.

The Russian world collection of wheats shows that there are four groups of early maturing wheats : (1) Arctic, (2) from continental regions of the sub-tropics, (3) from mountain regions, (4) from countries of periodic rain such as China and Japan. In other respects, however, these wheats are very different : those from the north need little warmth but much light, and those from the south are resistant to heat but need little light. By the requisite crossings early maturing forms can be raised with varying reactions according to the latitude for which they are required.

Great improvements have been carried out in India on wheats and barleys so that they can now compete in quality with any in the world. At Pusa, types resistant to all the three rusts prevalent in India have been produced. In Egypt since 1921, work has been carried out with great success in the improvement of cereal crops by hybridizations between the native forms and imported varieties. In Australia, collections of cereals from all parts of Australia and other countries have been made in order to breed types fitted to all the very varied conditions of the continent. Three or four hundred valuable new lines have already been isolated and are undergoing exhaustive trials. All European countries as well as America are working on the same genetical lines, and the work done in cereals throughout the world is one of the greatest tributes to the success of modern genetics.

X-ray experiments with wheats show that each variety has its own particular reaction. The soft spring wheats give a great variety of mutants, while the durum varieties give a larger number of mutants but a limited number of types.

In China, work is being done in the hybridization of cultivated rice with the wild forms. A valuable new variety with vigorous growth, resistant to cold and to a high percentage of acidity in the soil, has already been produced. In Japan, experiments with X-rays, ultra-violet rays and temperature changes has induced all the known mutants of rice and other new ones, and in some cases mutants ripened 11 days earlier than the parent.

Lupins.—The Kaiser Wilhelm Institute have put on the market new alkaloid-free lupins which will grow on the most unfavourable light soils and produce extraordinary quantities of green fodder. Crosses between bitter and sweet lupins showed that absence of alkaloid is a simple recessive. The Russians have also done very much in the production of alkaloid-free lupins, having made two and a half million analyses in two years. The great advantage of these new lupins is their high yield and protein content and their capacity for growing on sandy soils where other crops cannot be produced. A common bitter lupin has been discovered with 21 per cent oil content against the usual 4 to 6 per cent, and it is hoped to combine this new feature with the alkaloid freedom. Disease resistance is also being investigated.

Rubber.—The Russians have made expeditions also to discover new rubber plants suitable for cultivation in their temperate regions. Analyses of 1,048 species of 316 genera belonging to 95 families have been made, and rubber was found in 609 species. The best results were obtained within the *Compositœ* family. A plant found in the Caucasus, *Scorzonera tau-saghyz* showed a higher rubber content than any plant known, the rubber being of high quality and easy to extract. Its unusual capacity for regeneration was also a marked peculiarity of this new species.

Tobacco.—In Russia, work is constantly proceeding to combine the hardiness and adaptations of local varieties with the finer flavour of more desirable varieties. Many extremely interesting compound types have been built up containing the chromosome complexes of three species of tobacco. Much segregation occurs, and desirable new types can be fixed in later generations. These synthesized varieties form a valuable reservoir of new and valuable forms, and correspond to the similar experiments in cereals. In America several pure-breeding new species and varieties have been built up in this way, by hybridization followed by chromosome duplication or segregation. The use of ultra-violet rays was found to give rise to conditions of greater fertility in the hybrids. Goodspeed and others find that the tobacco plant is a specially good subject for X-ray treatment, and several useful mutants have arisen by this means. In one case fourteen different types were obtained from a single X-rayed sex cell; seven were pure-breeding derivative types, the others are not yet constant.

Much work has also been carried out with such crops as bananas, sugarbeet, cacao, coconuts, coffee, hemp, potatoes and sugar.

In so short a space it is not possible to deal adequately with any one of the many lines of research being pursued, but enough has been mentioned to show how very much alive scientific plant-breeding is all over the world. Just as new genes are being introduced into existant crops, by the utilization of new species and local forms, so other wild species are being tested and tried out to produce new types of crops. Although the Russians have led the world in the exploitation of

world resources, yet there are still untapped reservoirs of wild plants in the Soviet Union itself, many of which are promising new sources of rubber, fibres, etc. The great forests of South America are still largely unpenetrated by man, and one may expect vast stores of vegetable wealth to be had there for the seeking. Above all in China there is an unparalleled wealth of species and forms, often extremely localized. The intermingling here of tropical and temperate floras has resulted in the evolution of a vegetation of unequalled richness and variety. Our own plant collectors have shown us to some extent the horticultural treasures which are to be found there, but the great store of economic forms is still scarcely touched. Chinese forms are also generally characterized by a happy immunity from disease, and many cold-resistant forms of fruits, etc., which are at best only half hardy in the case of those now in cultivation, exist in the northern mountains and at higher altitudes in the south. Excessively late or early forms, wide variations of colour, form, size, flavour, yield, etc., promise an almost inexhaustible store of genes for the future. Thus we may look forward to a very considerable improvement in all our economic crops, fruits, vegetables, and flowers within the next few years with special adaptations to all the diverse environments of the various continents. The future of plant breeding is indeed bright, and although much labour will be involved it will be more than worth while in the usefulness of the results.

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CALF REARING

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WHEN milk products are sold, attention should be devoted to every possible source of wastage, which tends to lessen the regular monthly income. The rearing of calves usually proves costly. Consequently it is necessary that the minimum quantities of milk on which a calf can be reared normally, without in any way impairing its health, should be known.

A mistake often made in this country is the indiscriminate rearing of every calf born. It would be far more profitable to select for rearing only calves which, to the owner's mind, would justify the time and expenditure involved. Those calves that have no history in regard to production, or whatever quality is desired, should be sold as veal or even destroyed.

When a calf is hand-reared, there is no reason why it should not thrive and be in just as good health as the beef calf, which is allowed to run with its dam and suckle whenever it wishes.

Many farmers are situated in parts of the country where there is excellent cattle veld, but no possibility of growing supplementary feed, owing to the low rainfall. Where transport facilities exist in such areas, dairy-ranching is generally resorted to, with success. It would not be advisable, however, under these conditions to farm with high-producing cows, as they are liable to milk themselves to death.

Under dairy-ranching conditions, calves are reared in a number of different ways. There is always the temptation to procure as much milk as possible from the cows, often with irreparable losses as far as the health and growth of the calves are concerned.

Calves are in some cases allowed to suckle only a little before and after the cows are milked. During the day they are grazed in a small paddock. Calves reared under such conditions are stunted and thin, as a result of mineral deficiency and a possible protein shortage. It would be advisable to supplement these deficiencies in the form of a lick. The quantity of milk allocated to each calf is often regulated by allowing the calf to have one or two quarters of the udder at each milking. Although this may be described as a step in the right direction, the calf is practically certain to receive an inadequate milk supply. The reason for

this statement will be appreciated when one considers the fact that many cows on dairy ranches only produce about one gallon of milk daily, a quantity necessary for a two-weeks-old calf.

In order, therefore, that the calf may have a good start in life, it seems advisable to milk only once a day. Greatest success in the raising of calves is attained where the calves are separated from their dams in the evening, and the cows are milked the following morning. During the day, the calves should be allowed to run with the cows in the veld. Small calves are capable of walking for remarkably long distances , in fact, herd boys usually find it difficult to manage a herd of cows with their calves. For these reasons, and transport conditions, some dairymen prefer to milk in the evenings the calves being shut up in the kraal during the day. It must be pointed out, however, that calves which run with the cows during the day will learn to graze the natural veld at an early age.

Calves should be adequately supplied with fresh clean water at all times.

Under dairy-ranching conditions, calves should be supplied with phosphatic supplements at an early age. These animals do not receive the quantity of milk and additional concentrate supplements usually fed where calves are hand-reared. Phosphorus may be supplied, either in the form of licks or dosed daily to the animals. The daily quantities to be dosed are bone meal 3 ounces, or degelatinized bone flour 2 ounces, or di-calcium phosphate 1 ounce, to be put on the back of the tongue with a spoon. The two last-named substances should be moistened with water before being administered. Licks are mixed in the following proportions by weight : 3 parts of bone meal and 1 part of salt, or, 2 parts of degelatinized bone flour and 1 part of salt, or, 2 parts of degelatinized bone flour and 1 part of salt, or, 1 part of di-calcium phosphate and 1 part of salt.

When di-calcium phosphate is used, a guarantee should be obtained from the seller, giving the fluorine content of the substance. If the fluorine content of di-calcium phosphate exceeds 0·5 per cent, it may prove harmful to animals.

The present high standards of maximum milk production have created a cow giving quantities of rich milk much in excess of the normal requirements of the calf. It would therefore be unwise, from a health point of view, to allow a calf from such a cow to gorge itself with milk. The digestive system of the young calf is very sensitive to changes of diet, quantities of feed, dirt and changes of temperature. Hence it is at all times necessary to be absolutely punctual and very precise in the matter of feeding. Strict adherence to the factors just mentioned will ensure a happy ‘ flashy ’ calf, whose unstunted growth will soon repay the extra attention vouchsafed to its feeding and management.

In urban areas whole milk is generally retailed, the result being that there is no skim milk available for calf rearing. In some instances such dairymen resort to nurse-cows, with success.

Care of the cow

It is desirable that the cow should be in a good physical condition prior to calving, in order to ensure a healthy calf. The cow should be dried off 6 to 8 weeks before the time of calving. During this ' dry ' period she should receive a good, fairly nutritious and laxative ration. The nutritive requirements of the foetus for the greater part of the gestation period are naturally small, yet it is necessary to supply the cow with an adequate supply of feed to build a well-developed calf. Failure to give a good cow the needed rest results in her having to start the next lactation on too low a plane of condition. The feeding problem of a cow that is due to calve is practically solved where she has access to good grazing. If the cow is low in condition, she should receive, in addition to pasture, 4 or 5 lb. of grain daily. A good grain mixture may be made from equal parts of maize meal, wheat bran and ground oats. If no grazing is available, it is essential to supply the cow with some silage or green feed, in order to provide a laxative ration. About a week before calving, the grain ration may be reduced or completely withdrawn. A few feeds before calving may consist of a wet mash of equal parts of ground oats and bran, mixed with warm water. Every effort must be made to keep the cow from becoming constipated, as this increases the possibility of difficulty at calving.

Exercise for the dry cow is essential. A 2-gallon (16 to 20 lb.) cow should not take longer than 2 weeks to dry off. A good plan is to keep such a cow in the byre ; if she is accustomed to graze, cut off her grain ration and give hay only. Milk only once daily for the first four days, then relieve the udder every other day for a period of about a week. It is wise in this connection to be careful, but not unduly alarmed. Unless the udder has some defect, no harm will result. When the udder is dry and in a good pliable condition, feeding may be resumed.

Care of the calf

Provision should be made for the calf to be born in sanitary quarters. The pen must be clean, light, well ventilated and comfortable. In order to avoid infection by any of the calf diseases, the pen should be cleaned and lime and dip used on the floor, as well as clean straw put down for bedding. It is advisable to allow the cow to occupy the calving pen for a few days prior to calving. Weather conditions generally favour outdoor calving in this country. This is desirable, provided that the cow calves in a clean grassy paddock. During the ordeal of calving, careful and prompt attention may be necessary. Experience enables one to gauge fairly closely when the calf will come. The pronounced loosening of the vulva and the ' falling away ' on either side of the tail setting form a fairly reliable indication that calving is near. Another reliable guide is the filling and distention of the teats. During calving, the cow should be disturbed as little as possible. A cow should calve down within an hour of onset of parturition.

If the cow has calved normally, she will immediately lick her calf. This act assists in drying the calf and starting respiration, and also helps blood circulation. Should foetal membranes cover the nostrils, these must be removed promptly. It is always desirable immediately after birth to wash and disinfect the navel of the new-born calf with a disinfectant such as tincture of iodine or carbolic acid.

A strong calf will usually attempt to rise in about 15 or 20 minutes, and will be nursing within about half an hour. If after an hour the calf has not had a drink, it may be advisable to assist it by holding it up to the cow's udder. It is essential that the calf gets the first milk or colostrum, which has special laxative properties as well as additional qualities which are necessary to starting the new-born calf on its career. Colostrum, for instance, has the property of providing the calf with certain anti-bodies which fortify the animal against the many infections liable to occur at this delicate age. Occasionally, when the calf fails to receive the first milk or colostrum from its dam, the meconium is retained because the bowels remain inactive. In this case a teaspoonful of castor oil may be given at frequent intervals until there is a movement of the bowels.

Teaching the calf to drink

A good practice is to allow the calf to remain with its dam for one or two days. If the udder is much inflamed the frequent sucking by a calf is desirable. If let together longer, both the cow and the calf will be more disturbed when they are finally separated. Most calves will learn to drink in a few minutes, especially if they are hungry. The best method is to allow the calf to suckle one's fingers, when the hand can gradually be lowered into the bucket and submerged in the milk sufficiently deep to allow a little of the milk to be taken by the calf. The fingers can then be withdrawn gradually so as not to arouse suspicion. One lesson may suffice, but if it does not, the procedure must be repeated until the calf will drink from the bucket on its own. Here success comes only with patience.

The whole-milk period

As already mentioned, the hand-rearing of calves is in the best interests of both calf and dairyman, yet it is not always an easy task, and is perhaps most conscientiously carried out by older men. Some dairymen are inclined to favour the use of nurse-cows. This method of raising calves has its possibilities, provided cows of a suitable type are procurable, and that the number of calves allotted to each cow is such that they all get sufficient milk. For instance, one quarter of an old cow producing 4 gallons of milk daily could be given to each of four calves. This question must, however, be left entirely to the discretion of the farmer.

It is naturally desirable, for economic reasons, to have the whole-milk period as short as possible. Nevertheless, best results are always procured when conditions approximate to those of Nature. It has been shown that a 3 to 5 per cent

butterfat in milk facilitates an easier and more desirable passage through the digestive tract than does skim milk.

When the calf is taken away from its dam, it should not be overfed. There is generally more risk in overfeeding at this stage than there is in underfeeding. A useful rule is to give the calf approximately 1 lb. of milk daily for every 10 lb. of calf weight.

The birth weights of calves are approximately as follows : Ayrshire, 66 lb. ; Guernsey, 64 lb. ; Friesland, 94 lb. ; Jersey, 54 lb. Calves of all mixed breeds may as a rule be taken to weigh approximately 70 lb. at birth.

A Jersey calf weighing 54 lb. would, therefore, be given about 5·5 or, for ease, 6 lb. of milk per day, whereas the 94 lb. Friesland may get as much as 10 lb. The milk must be fed at about body heat. Best results are obtained when calves are fed 3 times a day at this stage. The general practice among many dairymen is to feed twice daily from the outset. It is necessary that feed buckets should be scalded and kept in a clean place after feeding. Irregularities such as unhygienic utensils may result in dirty and sour milk, which in turn is a certain cause of scours.

In ordinary circumstances the whole-milk period lasts for 3 weeks. The increase in milk fed from the first day is about ½ lb. every second day, until the calf is 3 weeks old.

The skim milk period

When a calf has been on whole milk for 3 weeks, skim milk is substituted for the whole milk. The change from whole milk to skim milk should take place gradually. The procedure usually adopted is to replace 1 lb. of whole milk by 1 lb. of skim milk daily until, after a week or ten days, the calf is entirely on skim milk. As a rule calves are fed skim milk until they reach the age of 6 months. Buttermilk or whey may to some extent take the place of skim milk. Both these feeds are, however, often stored in dirty containers.

It must be borne in mind that these substances are derived from mixed milks at creameries, and are liable to be *infected with tubercular bacilli* or other pathogenic organisms. Buttermilk is further unreliable in that it often contains excessive amounts of wash water. Whey, on the other hand, lacks the protein which is present in buttermilk or skim milk. When whey is used, success can be obtained only by inducing the calves to take a protein supplement, in the form of a grain mixture. The following grain mixture may be fed along with whey and a legume hay ; 3 parts of ground maize and 3 parts of linseed-oil meal. Dried skim milk is expensive in this country, but where it is obtainable it is mixed with water, and fed. One part of dried skim milk is added to 9 parts of water, and is then equal to 10 parts of ordinary skim milk.

When skim milk forms the major feed, Table I may be used as a guide.

TABLE I

Rearing calves on skim milk

Age of calf	Whole milk (lb.)	Skim milk (lb.)	Grain (lb.)	Hay (lb.)
1 to 2 days	With dam	..	..	..
2 to 14 days	5 to 10	..	..	..
2 to 3 weeks	10 to 1*	1 to 10*	$\frac{1}{8}$	Free access
3 to 4 weeks	..	10	$\frac{1}{4}$	,,
4 to 5 weeks	..	11	$\frac{1}{2}$	,,
5 to 6 weeks	..	12	$\frac{3}{4}$	,,
6 to 8 weeks	..	13	1	,,
8 to 12 weeks	..	14	2	,,
12 to 24 weeks	..	16	3	,,

* In the first case the whole milk is gradually decreased, while the skim milk is increased accordingly. Where dairy farming is practised successfully a milk scale becomes an essential. On the farm a gallon is taken to represent ten lbs.

WHERE ONLY A LIMITED QUANTITY OF WHOLE MILK IS AVAILABLE

It frequently happens that calves have to be reared on a limited quantity of whole milk, because no skim milk is available. In this case it should be remembered that the secret of success lies in giving the calves a good start on whole milk. At the same time, they should receive every possible encouragement to eat grain and hay. The whole-milk requirements of calves reared in this manner, according to Mr. C. A. Murray, Matopos School of Agriculture, Southern Rhodesia, are given in Table II.

Another method of raising calves on a minimum quantity of whole milk is to give a milk substitute. No such substitute can, however, take the place of milk with entire satisfaction. The calf meals or gruels are not as easily digested as milk, with the result that digestive disturbances are more common. A simple gruel may be mixed, in equal parts by weight, as follows ;—

Linseed meal, blood meal, and pollards.

Table II

Raising calves on a limited quantity of whole milk

Period in days	Period in weeks	Whole milk per calf daily
1st day with dam	..	..
2nd day, dam's milk	..	4 pints
3rd to 7th days, dam's milk	..	6 ,,
	2nd week	8 ,,
	3rd ,,	10 ,,
	4th ,,	10 ,,
	5th ,,	12 ,,
	6th ,,	10 ,,
	7th ,,	8 ,,
	8th ,,	6 ,,
	9th ,,	4 ,,
	10th ,,	2 ,,

One part of the above gruel mixture is mixed with 8 parts of water, and brought to the boil. The gruel is then allowed to cool, but should always be fed at body heat. Where gruel is used as the major feed, calves may be fed as shown in Table III.

Table III

Feeding gruel to calves

Age of calf	Milk (lb.)	Gruel (lb.)	Grain (lb.)	Hay (lb.)
1 to 2 days	With dam	..	..	..
2 to 14 days	10	..	..	..
2 to 3 weeks	9	1	..	..
3 to 4 weeks	9	3	$\frac{1}{8}$	Free access
4 to 6 weeks	6	6	$\frac{1}{4}$	,,
6 to 8 weeks	..	12	$\frac{1}{2}$	,,
8 to 12 weeks	..	14	1	,,
12 to 16 weeks	..	14	2	,,
16 to 20 weeks	..	..	4	,,

The feeding of grain and hay

There is considerable doubt as to the desirability of allowing a calf roughage at too early an age. Calves will be seen to nibble at feeds when they are only a few days old. A few handfuls of grain and a little hay may be given in order to induce them to eat. At 3 weeks, calves will consume approximately the quantities

given in the accompanying tables. These are only approximate guides, and should be followed with discretion. Calves should be fed so that their mangers are always clean. They relish whole grain, whole maize or oats may be given. It may also be desirable to feed bran or oilmeal, but never feed cotton-seed meal to calves. A mixture that has given excellent results is : 3 parts of ground maize, 3 parts of crushed oats, 1 part of bran, and 1 part of linseed oil meal. This grain-mixture may be modified to some extent, with equally satisfactory results. The main thing is to watch for digestive disturbances. If these occur, the grain mixture will either have to be cut down or changed. Perhaps all that will be necessary is to give less lucerne hay. Bran and oilmeal are desirable on account of their added phosphorus and protein content, as well as laxative effect.

Feeders differ as to the desirability of silage for young calves. There is, however, no danger as long as calves consume all the silage before them. Danger of scours occurs only when silage has been allowed to accumulate in the mangers, or when it is mouldy. When calves are properly fed, there is no need for them to be let out to pasture. Pasturing calves before they have reached 6 months of age tends to make them paunchy.

Calves should always have free access to fresh clean water. An abundant milk supply does not make up for the water that a calf requires.

If calves are reared along the lines prescribed above until they are 6 months old, no mineral supplement will be necessary. Serious consequences may be expected should a nutritional deficiency occur during the first six months of a calf's life. The ration should be such that the calves will make at least normal growth for the breed, which according to the Missouri Research Station, is given in Table IV.

TABLE IV

Normal weight and height at withers of females

Age (months)	Friesland		Jerseys		Ayrshires	
	Height (inches)	Weight (lb.)	Height (inches)	Weight (lb.)	Height (inches)	Weight (lb.)
Birth . .	28.3	90	26.0	55	..	69
1 . . .	30.2	121	27.7	76	27.5	90
2 . . .	32.3	157	29.4	105	29.5	128
3 . . .	34.2	200	31.2	140	31.2	170
4 . . .	36.2	249	32.9	174	33.1	218
5 . . .	38.0	302	35.1	222	35.1	254
6 . . .	39.7	349	36.9	260	36.4	286
7 . . .	40.9	389	38.1	302	37.3	304
8 . . .	42.2	425	39.3	340	38.5	336

Age (months)	Frieslands		Jerseys.		Ayrshires	
	Height (inches)	Weight (lb.)	Height (inches)	Weight (lb.)	Height (inches)	Weight (lb.)
9 . . .	42.9	466	40.5	376	39.0	366
10 . . .	43.8	501	41.3	407	39.6	406
11 . . .	44.3	529	41.9	432	40.1	427
12 . . .	44.8	558	42.6	456	40.7	456
13 . . .	45.6	574	43.3	480	41.3	485
14 . . .	46.2	596	43.8	503	42.0	533
15 . . .	46.8	612	44.4	520	42.4	547
16 . . .	47.4	643	44.6	533	42.7	560
17 . . .	47.7	660	45.1	553	43.1	579
18 . . .	47.9	686	45.5	572	43.7	604
19 . . .	48.3	715	46.0	598	44.2	627
20 . . .	48.7	746	46.3	621	44.6	651
21 . . .	48.9	774	46.5	649	44.9	679
22 . . .	49.2	796	46.8	668	45.4	707
23 . . .	49.5	824	47.2	689	45.6	733
24 . . .	49.8	841	47.4	716	45.9	759

Common calf troubles

When calves have had their milk feed, they will invariably start suckling each other. This vice often becomes serious, for not only is hair swallowed, but udders, navels and scrotums may be damaged. A good plan is to feed the grain mixture after the calves have finished their milk. Cheap but effective wooden stanchions are often employed to prevent this vice, and make the feeding of calves safe and easy. These are made by bolting uprights, 6 inches apart, to a horizontal beam placed along the ground. A second horizontal beam, about 4 feet high, completes the stanchion, every second upright being left loose on the upper beam, so that it acts scissors-like, and the head of the calf may easily be secured.

More calves are stunted because of common scours than through insufficiency of feed. This defect is liable to occur under the best feeding conditions. The most frequent cause of common scours is overfeeding. Hence it is always essential to reduce the feed. Good results have been obtained by reducing the milk feed to half the daily supply. Water is then added to the milk, making the feed up to 1 part of milk and 1 part of water. The calf may be fed on water and milk until improvement is noticed. The quantity of water is then gradually diminished and substituted by milk, until the calf is on its regular quantity of milk. The usual method of treating calves that have common scours, is to give them a dose of 1 to 3 ounces of castor oil. A tablespoon of lime water may also be added to each quart of milk.

Flies often abound in calf pens and where calves are fed. Many fly repellants may be used, but greatest success is usually attained by applying preventive measures. Flies hatch in wet and damp places, or in the droppings of animals. The best method of dealing with flies is, therefore, to keep the surroundings clean and dry.

MANAGEMENT OF THE YOUNG HEIFER

Calves are generally weaned at six months of age. At this stage the bull calves should be separated from the heifer ones, in case accidental breeding may take place. There is an erroneous idea among many stockmen that calves may be allowed to fend for themselves after they have been weaned. Although it would be a mistake to pamper young animals they must not be allowed to become stunted. Young stock of about 9 months of age will take 15 to 20 lb. of green feed or silage each per day, and 10 lb. of roughage, such as hay. The best hay in this country is lucerne hay. As long as green feed and roughage exist, there is no need for grain concentrates to be fed. When no pasture or hay is available, a grain supplement should be given. One of the simplest concentrate mixtures in equal parts by weight, which is often used with success, is wheat bran and maize meal. This mixture, supplied at the rate of 2 to 5 lb. per animal daily, will be sufficient.

WHEN TO BREED HEIFERS

There is often a tendency to breed heifers early, in order to hasten the long period of unproductivity. Animals should, however, be allowed to grow out properly before being bred from. Frieslands and Ayrshires may be served at from 18 to 20 months of age, and Guernseys and Jerseys at from 15 to 18 months. The ages given serve only as a rough guide, service depending upon the development of the heifer.

THE USES OF COTTON SEED

BY

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MUCH has been written in recent years about the close connection between the price of cotton and the tendency of the growers throughout the world, especially in America, to reduce or increase the area under cotton according to the actual cash return they receive for the crop. In such calculations, however, it must be remembered that the price received for the cotton seed is also a factor in the economic yield of the crop, and sometimes a more important factor than is generally realized. In America a waggon load of 1,500 lb. of seed cotton produces approximately a 500-lb. bale of cotton lint and 1,000 lb. of cotton seed, but it will be seen from the following table that the proportions of the total cash return to the planter which come from the lint and the seed respectively have, to take only recent years, varied very greatly.

TABLE I

Estimated prices received by growers for cotton lint and seed

—	Prices		*Total prices received			
	Cotton (Cents per lb.)	Seed $ (per ton)	Cotton ($)	Seed ($)	Total ($)	Seed per cent of total
May 15, 1930	14·5	30·61	29·00	6·12	35·12	17·4
Do. 1931	8·8	22·32	17·60	4·46	22·06	20·2
Do. 1932	5·2	9·66	10·40	1·93	12·33	15·7
Do. 1933	8·2	12·00	16·40	2·40	18·80	12·8
Do. 1934	11·0	22·23	22·00	4·45	26·45	16·8
Do. 1935	12·0	39·36	24·00	7·87	31·87	24·7

Thus in the 1934-35 season the drought in America produced a great shortage, not only in the cotton crop, but also in the supply of hogs (depending on the corn crop, which suffered even worse than cotton) and therefore of lard, as well as in other vegetable oil seeds, with the result that the price of cotton seed shot up to levels that have not been seen for many years.

* Based on a yield of 200 lb. of lint per acre and 400 lb. of seed.

The reason why the prices of cotton and cotton seed move almost entirely independently of each other lies in the fact that the uses of cotton seed bring it into a world market in which cotton seed plays a relatively small part, and its price is therefore affected largely by the supply of all the other commodities which enter into that market. It should therefore be of interest to cotton growers to have some idea of what these other commodities are and how they compete with cotton seed.

The development of the cotton seed trade, with the extraordinary variety of uses to which it is now put, is one of the romances of modern industry. At first the seed was regarded in many countries almost as a nuisance which cost money to get rid of, unless it could be used as manure or sometimes as fuel. Before the War it had become one of the stock illustrations of the utilisation of by-products ; now it is an industry in itself, with a turnover worth probably £50,000,000** per annum, and its products are the raw material of a hundred trades, from cattle-rearing to soap-making, edible oils and artificial silk.

The general outline of the processes of manufacture must first be described. Its nature depends in the first place on the character of the seed. American Upland seed and other similar varieties are what are known as " white " or " fuzzy ", owing to the short lint or fuzz with which the whole seed is coated, and which is not removed by the process of ginning. Egyptian and Sea Island seeds, on the other hand, are " black " or " clean " seeds, having no short lint or fuzz except occasionally a small tuft of short green lint on the pointed end of the seed. In America, therefore, it has always been customary to put the seed through what practically amounts to a second ginning process called " delinting ", and the short lint thus obtained is what is known as " linters ". These used to be regarded as of comparatively small commercial value, being fit only for such purposes as gun-cotton or blotting-paper, or for mixing with waste cotton in spinning low-count yarns ; but they constitute quite a considerable proportion of the American crop—say, 1,000,000 bales—and it is a curious fact that the amount of the linters crop does not vary in proportion to the lint crop. On the average of the last ten years, however, the linters crop was about 7½ per cent of the whole crop. A similar process has for many years been applied to Indian cotton seed or Bombay seed, as it is generally called in European markets, as well as to Chinese, Russian, Brazilian and African cotton seed. Even after delinting, however, the greater part of the short fuzz still remains on the seed. Since the War an important new use for linters has been as the raw material of artificial silk, though this use has not yet been fully developed in England owing to the high cost of securing the necessary cleanliness or cellulose purity of the

** The world's cotton crops now amount to about 25 million bales of 500 lb. Every bale of cotton lint represents roughly 1,000 lb. of seed, so that the total cotton seed crop must be about 12 million tons, with an average value of, say, £4 per ton. The value of the finished products is of course much larger.

product. The best linteres are now worth rather more than half the price of American Middling cotton, but lower grades go to much smaller prices.

The next process in the case of American seed is decortication, which consists practically of cutting or cracking the seed so as to separate the kernel from the husk, with the fuzz which still adheres to it. In Egypt and in Europe (except where seeds of the American type are handled) the whole seed is crushed without separating husk and kernel, and Bombay seed is treated in the same way as Egyptian. In China, where cottonseed crushing began only about 1910, the American methods are followed, and the same applies generally to the Russian crop, most of which is now of the American type of seed.

The meal or crushed kernel, or the whole seed crushed, as the case may be, is then heated by steam in an enormous kettle, after which it is put into bags or wrapped in cloths in an oblong shape ; it is then pressed in hydraulic presses of great power, thus extracting the oil and at the same time giving to the remainder the peculiar form in which it is so well known as cake for cattle-feeding purposes. There is now an alternative method, known as the Expeller process, of extracting the oil from the crushed seed by forcing it through a tapered cylinder by the action of a heavy rotating screw. In this machine the residue or cake is thrown out in a broken condition, and is known as Expeller cake.

The crude oil from the presses is refined by various processes, chiefly based on the use of caustic soda, and is used either as edible oil or for soap-making, according to its quality. In the case of Egyptian oils made from undecorticated seed, a small quantity of dark resinous matter exudes from the husk in the crushing process, which darkens the colour of the oil and gives it a peculiar flavour. To remedy this it is necessary to use stronger chemicals in refining the oil, but until the discovery of the deodorization process about 1910 it was never possible to eliminate the peculiar flavour entirely, and this seriously handicapped the use of these oils for edible purposes.

The black grease or refuse of the oil-refining process goes through various further processes, by which still other by-products, such as glycerine and white candle grease, are taken from it. The residue is at last reduced to the consistency of pitch, and in this form it is spread upon brown paper with a thin layer of coarse cotton fibre on its surface, thus forming the familiar waterproofed wrapping paper in which many forms of textile and other goods are packed, especially for export. This pitch is now also used for insulating covered electric wires. There is also another refining process by which a cheap form of soap (useful for textile purposes) is produced directly.

In view of the predominance of the American crop in the world's cotton supply, American cotton seed still supplies the bulk of the cottonseed oil trade. It is chiefly manufactured in the United States, and is largely consumed in that country, as well as being exported to all parts of the world in normal seasons. A considerable quantity of cottonseed meal is also exported, but the cake is mostly

consumed in the United States. The Egyptian crop is partly crushed in Egypt, though the greater proportion of it is exported in the form of seed to European ports. Some of the Bombay crop is also exported, chiefly to the United Kingdom. France and Germany used to take a considerable share of the Egyptian crop, but since the War England has taken the lion's share, and since 1931 the Continent's share has been very small.

The English cotton seed industry is centred in Hull, Liverpool and London, with a considerable trade also in Glasgow, Leith and Bristol. It used to be confined practically to Egyptian and Bombay seed, Egyptian being more than half of the total, but in recent years increasing quantities of Empire seed from East and West Africa and also of Brazilian white seed have been coming to the United Kingdom. Egyptian black seed, however, still forms the bulk of the U. K. trade. The finished products must, of course, face the competition of those of the American industry.

In discussing the relative value of different oil seeds it is necessary to keep in view the two main products of the seed—namely, oil and cake. Thus, as regards the quality of the oil produced, the American method was superior for the production of high-class oils ; the removal of the husk or shell by decortication and the use of the crushed kernels alone for the production of oil produced a finer quality of oil than could be obtained by crushing the whole seed. Accordingly the standard grade of American sweet oil, known as "Prime Summer Yellow", used to represent the highest quality among the world's cottonseed oils, while the Egyptian came next and Bombay last. The application of the American method of decortication to other varieties of white seed in England has, however, produced oils quite equal to the American.

The market for cottonseed oil is highly complex or composite, alike from the side of supply and of demand. Cottonseed oil enters into two formerly distinct markets which may be generalised as edible oils and soap fats, and in each of these fields it had competitors innumerable. Thus, as edible oil, it had to find its place in a long list containing all the animal fats, lard, and even butter itself, as well as all the other edible vegetable oils, especially olive oil. In this branch of the market American cottonseed oil, until before the War, stood almost alone. Egyptian oil, owing to the peculiar flavour above referred to, was so far behind the American as to be hardly a competitor at all, while Bombay cottonseed oil was not regarded as possible for edible purposes. Bombay oil, along with a number of other vegetable oils such as those obtained from linseed, maize, soya beans, rubber seed, copra, cocoanut, palm oil, sunflower and many others, the very names of which are hardly known to the average layman, had their places at various points in the supply of vegetable oils ; they were mainly used in the soap and candle trades and other manufactures, where also until then Egyptian cottonseed oil found its chief demand. In this trade the vegetable oils had to compete with tallow, whale oil, and other low-grade animal fats, the

better qualities of which came into the more profitable market for edible products. Linseed oil had, of course, its own special market for paint mixing, and in this it had practically no competitor, though laterly soya bean oil had been tried for this purpose with some success. Mineral oils such as petroleum are, of course, an entirely separate branch of the oil trade.

Conditions, however, have altered very materially since about 1910 in all trades into which cottonseed oil enters, and the relative position of the different products has been entirely changed. It is impossible to enter into these changes here in detail, but on the whole they have been in the direction of improved methods of dealing with what were formerly the lower-grade oils from the edible point of view, such as Egyptian and Bombay. In 1910, owing to the failure of the usual supply of edible oils and fats, such as olive oil, American cotton seed and American hog lard, a great deal of attention was devoted to discovering improved methods of handling these crops especially the Egyptian so as to improve the quality of the product from the edible point of view. It must be remembered that the chief use of oil for culinary purposes in England is not as oil-butter, the most expensive form of animal fat, has always taken in England the place filled by oil in Europe—but in some composite or made-up form, such as lard, margarine, etc. Until 1910 the makers of these goods preferred either animal fats or the finer American sweet oil. But in 1909 there was an extraordinary combination of disastrous shortages in almost every branch of the supply of edible oils and fats, with the result that the consumers were forced to turn their attention to other sources of supply and particularly to Egyptian oil. The result was a marked change in the position of cottonseed oil in the English markets. It was no longer merely a soap fat, but also an edible oil (as it had always been in Egypt) and therefore able to command a higher price, which was still further augmented by the general high level of prices of all edible oils. In 1911, however, the enormous American crop entirely reversed the conditions, and the value of Egyptian oil returned to something like its former relative position, while the lower price of American oil again made it available for soap-making.

In the same way, but to a more marked degree, Bombay oil had before the War been looked upon in England as quite impossible for edible purposes, but in modern industry it is not safe to say that anything is impossible, and by about 1910 oil-refiners had succeeded in producing quite satisfactory edible oils from Bombay seed.

Many other oils have passed through a similar phase. Thus, copra and palmkernel oil were found adaptable (under pressure of unusual demand) for certain edible purposes, especially margarine, and even soya bean oil, which at first was classed as only fit for soap-making, soon proved a useful substitute for linseed oil, and was then, by still further refining, made into good salad oil.

Again, about 1912 a new process of deodorizing oils produced almost a revolution in the supply both of soap fats and edible oils. This process, first introduced in America, consisted in blowing superheated steam through the oil, thus removing all objectionable flavours and making it possible to extend enormously the possible sources of supply of edible oil.

Again, a new hardening process was still more of a revolution. The original patent was taken out early in the century, but it was not until about 1911 that it became possible to apply the new method commercially. Broadly, the whole group of oils or fats used to be divided into two sections—soft or liquid oils, and hard or solid oils. Linseed, cotton, rape, whale oil, etc., belonged to the first group ; cocoanut and palm oil, etc., to the second group. There was formerly a difference of nearly £10 per ton between the soft oils and the hard oils in favour of the latter, owing to the fact that a certain proportion of hard oil had to be used in the manufacture of margarine and soap in order to produce a firm product. The new invention was based on the discovery that by the removal of certain constituents soft oils could be converted into a hard stearine. Thus, linseed oil, whale oil and cottonseed oil, when treated by this new process, became harder and more solid than even tallow. The cost of the process is now about £5 per ton. The result was to draw the two groups closer together in value, because of the readiness with which the one could now be substituted for the other. The effect of such a revolution as this was not to increase the available quantity of fats and oils for the world's consumption, but rather to change the course of markets from one industry to another. As far as cottonseed oil is concerned, the result was that the whole output became available for edible purposes in the form of hard fat, but a further supply of that or some other material was needed to meet the requirements of the soap trade.

Another important development in the last ten years is the large increase in the world's production of whale oil, which in one year (1931) reached the enormous total of 3,689,631 barrels (of which six go to a ton) as against about 750,000 barrels before the War. This was, of course, entirely excluded from use as edible oil until the development of the new processes above referred to, but these have completely altered its position. The fact is that the distinctions between edible oils and soap fats and between soft oils and hard fats now hardly exist, and almost any oil or fat can be made available for almost any purpose.

Table II summarizes the world's production of the various oils, animal and vegetable, and indicates the relative importance of each source.

A word may be added as to the relative values of other varieties of cotton seed, especially Empire, compared with American. It is difficult to get comparable figures because no quotations are available in England of American cotton seed ; but against the recent price of about $40 per ton in America the following quotations of different varieties in this country may be noted : Egyptian (black)

about £6 5s. per ton and "White sorts" about £4 to £4 5s. But the real difficulty is in comparing the prices actually received by the growers, for this involves not merely the prices of the different kinds of seed when they reach a world market, but the cost of getting the seed from the grower to that market, and of course, with a commodity like cotton seed, of which the bulk is very great in proportion to its value, this cost is extremely high. In Uganda, for example, cotton seed was almost unsaleable in 1933-34 because the cost of the long railway haul to the port and thence by sea to England was almost more than the very low price which such seed was fetching in England at that time. In 1934-35, however, owing to the scarcity above referred to and the better prices obtainable for all classes of seed, the growers were able to secure a price of about 25s. per ton. That, of course, compares very badly with the $40 paid to the grower in America, but the difference is largely due to the fact that in the American Cotton Belt the market for the seed is at the growers' very door, for seed-crushing plants are scattered all over the Belt. The difficulties of setting up similar plants in the comparatively small areas of the Empire cotton fields are almost insuperable.

TABLE II

World's production of vegetable oils and fats

(From Messrs. Frank Fehr and Company's Annual Review)

	1929	1930	1931	1932	1933	1934
	Tons	Tons	Tons	Tons	Tons	Tons
Olive oil	1,007,000	500,000	739,000	810,000	751,000	813,000
Cocoanut oil	925,561	827,749	757,744	696,035	793,650	805,169
Cottonseed oil	802,466	767,320	775,242	822,643	767,638	748,257
Groundnut oil	698,802	697,888	708,339	480,134	576,860	601,004
Linseed oil	686,719	570,805	629,885	628,083	533,793	492,271
Soya oil	365,924	320,519	327,556	370,131	344,252	350,888
Sunflower oil	250,957	301,419	303,228	255.400	279,962	230,117
Palm oil	230,933	273,746	252,204	272,290	330,949	348,000
Palmkernel oil	211,638	211,229	190,645	228,296	185,682	203,560
Castor oil	65,076	54,320	54,352	45,591	51,206	47,407
Wood oil	63,000	70,000	50,000	47,220	72,611	65,000
Rapeseed oil	52,395	34,872	31,923	49.265	34,287	22,445
Sesame oil	40,188	46,800	27,224	21,020	21,976	16,517
Margarine*	1,312,500	1,148,000	1,087,658	1,010,567	910,138	893,366
Butter	1,291,887	1,315,000	1,761,000	1,518.950	1,615,062	1,583,300
Lard	799,730	689,805	693,758	702,437	792,230	681,875
Tallow	290,965	284,452	321,629	315,284	362,011	332,032
	7,783,241	6,965,924	7,668,729	7,262,779	7,513,169	7,340,842
Whale oil	310,312	466,755	615,700	149,458	425,067	413,058

*Not included in total as it is the product of other oils

ABSTRACTS

Blight and hollow-stem of sorghum. B. N. UPPAL, K. G. KOLHATKAR and M. K. PATEL. (*Ind. J. Agric. Sci.*, **6**, 1323)

THE writers have described a new disease in *jowar*, which is common on " bhata " soils in Broach and on medium black soils in East Deccan. The fungus enters the plant through feeding roots and ascends the stem and may be traced up to the ear-head. There is no external evidence of the disease until the plant approaches maturity. At this time infected plants are found to have hollow stalks and produce a characteristic sound as they are forcibly shaken by wind ; hence the disease has been given the name " hollow-stem ". Seedling blight is also common and may become very destructive under conditions of high soil temperature and high soil moisture content.

The fungus normally forms sclerotia, but Mohol strain also produced the pycnidial stage on *jowar* seedlings grown in Roux tubes.

The disease is most active at high soil temperature (35°C.) and high soil moisture content. The disease is more common in clayey soils than in silt loams.

The morphology and cultural characters of the fungus have been described. (*Authors' abstract*).

Studies in sorghum—The Great Millet. III. Anther, pollen and stigma. G. N. RANGASWAMI AYYANGAR and V. PANDURANGA RAO. (*Ind. J. Agric. Sci.*, **6**, 1299)

IN sorghum the anthers vary in size but not in shape. The commonest cultivated varieties possess the biggest anthers. The pollen grains also vary in size and roughly parallel anther-size differences. *Dummy Pollen* is peculiar to sorghum. It occurs in *Pennisetum typhoideum* also. Its incidence and function are detailed. It is found that its incidence in numbers large enough to ensure anther opening is a simple dominant to poor incidence leading to non-dehiscence and sterility.

Sorghum pollen is highly sensitive to the medium in which it is grown. Forty-one per cent sucrose with 0·75 (summer) and 1·5 (winter) per cent shred agar is found to be the best medium for the artificial germination of pollen. Germinations are better on cloudy, humid days than on hot, dry days. Considerable variation is found in the germination percentage of cultivated varieties. Compared with the night flowering varieties, the day flowering one gave a much higher germination percentage. Pollen from staminate flowers have a distinctly lower percentage of germination and the tube length is comparatively shorter. Though pollen germinates from 2-10 A.M. best germinations are obtained from material between 7 A.M. and 8 A.M.

Low temperatures have a distinctly beneficial effect on pollen germination. Up to 40°C. the germination is fairly good but beyond that there is a sudden drop in germination bordering on the lethal. Darkness inhibits the germination of pollen. The pollen grain has a tube nucleus and two generative nuclei. In *S. margaritiferum* and *Andropogon annulatus* the nuclei are spindle shaped. In *S. durra* they are larger and more elongated. In the initial stages the pollen tube from the pollen of staminate flowers grows slower than that in bisexual flowers. To attain its maximum length the pollen tube takes three to four hours in artificial cultures. Under saturated conditions for 48 hours, 28 per cent of the pollen remains viable. Pollen is capable of fertilising up to the third day though in a very weak measure (21 per cent).

Stigmas have the shape of truncated spindles. Two types of stigmas—a brush-like common one and a bushy one characteristic of *S. Roxb.* var. *hians* and *S. Nervosum* —are met with. The germination of pollen on stigmas is very high. Stigma receptivity is impaired by rise of temperature or humidity and darkness inhibits it though desiccation of the atmosphere does not seem to affect it. Seeds set in stigmas that are 48 hours old after which there is only a weak setting leading to none on the sixth day. The percentage of setting decreases with the age of the stigma. The duration of a variety does not seem to influence the duration of the receptivity of its stigma. The role of the stigma seems to be primarily to maintain optimum moisture conditions for pollen germination. (*Authors' abstract*).

An illustration of the use of the χ^2-Technique of analysis on meteorological data. P. V. SUKHATME. (*Ind. J. Agric. Sci.*, **6**, 1292)

A TABLE is given containing the results of 240 counts of nuclei made with the Aitken portable counter in the open air at Kew Observatory on the 29th December 1933 between 11-47½ A.M. and 12-17½ P.M. The object is to ascertain whether a genuine change was brought about in the nucleus content of the air during the hour of observation or else the fluctuations in counts were simply due to errors of random sampling.

For reasons discussed by F. J. Scrase in his paper "On the Sampling Errors of the Aitken Nucleus Counter" (*Jour. Roy. Met. Society*, 1935) the data are supposed to have arisen in random sampling from Poisson population. A statistical technique known as the χ^2-technique of analysis, which is appropriate for the analysis of these data, is set out in a tabular form and applied to these data. It is found that a genuine change had, in fact, been brought about in the nucleus content of the air during the hour of observation. (*Author's abstract*).

The problem of the nitrogen supply of rice. Part 1. Fixation of nitrogen in rice soils under water-logged conditions. PRAN KUMAR DE. (*Ind. J. Agric. Sci.*, **6**, 1237)

IN Bengal and in Burma, rice has been grown on the same land year after year for centuries without the addition of any fertiliser; yet there has been no change in the fertility of the soils. As regards the nitrogen supply of rice, it is believed that

either sufficient nitrogen is fixed in the soils to compensate for the amount removed with the crop and lost otherwise or rice plants themselves assimilate elementary nitrogen like legumes. The object of the investigation described in this paper is to ascertain whether fixation of nitrogen takes place in the rice soils when they remain water-logged. Several rice soils from different parts of India have been examined. Fixation of nitrogen took place in these soils when they were water-logged and exposed to sun. Soils having slightly alkaline reaction fixed much more nitrogen than those with lower *p*H. In the former soils, heavy algal growth appeared after water-logging but in the latter very little growth was observed. The addition of lime in these latter soils stimulated both algal growth and fixation of nitrogen. Evidences were obtained to show that the fixation of nitrogen in water-logged soils is an algal process. (*Author's abstract*).

Mineral matter in the juice of sugarcane and its effect on the recovery of white sugar. I. P. E. LANDER and RAMJI NARAIN. (*Ind. J. Agric. Sci.*, **6**, 1218)

SUGAR refineries in the Punjab have always shown a preference for *gur* from the United Provinces over the local commodity, on the plea that the former yields a greater percentage of white sugar. This was alleged to be due to the defective methods of *gur* making followed in the Punjab. The authors have, however, shown that the low recovery may be due to the greater amount of mineral matter in the Punjab *gurs* and the sugarcane juice. Apart from this the Punjab canes are not inferior to those from the United Provinces and Bihar. The high mineral content of the juice canes must be correlated with the composition of the soil. It has been shown that the soils from all the three provinces are almost identical in mechanical composition and the nature and amount of their water and acid soluble salt content. The lower exchangeable calcium and the slightly higher *p*H values of the soils from the Punjab, however, seem to be the likely explanation of the greater ash content of the sugarcane juice in this province. Experiments with the object of studying the possibilities of modifying the ash content of the cane juice by treatment of the soil with chemicals and manures are in progress and the results will be communicated when ready. (*Authors' abstract*).

Inheritance of earliness in the United Provinces rices (I). R. L. SETHI, B. L. SETHI and T. R. MEHTA. (*Ind. J. Agric. Sci.*, **6**, 1246)

SOME crosses between early and late types of rice were studied for the inheritance of earliness and its relation to certain other characters. Lateness was dominant over earliness, the F_2 showing a clear split into late and early plants in the ratio of 3 : 1. The F_2 distribution covered the parental extremes, but the means of the two groups were statistically different from the parental means, having suffered a 'shift' toward the middle. The segregations in F_3 confirmed the observations made in F_2. The correlation between the durations of F_2 plants and the mean durations of their

F_2 families was close and positive. There was a definite relation between the flowering durations of late F_2 plants and their genetic constitutions, the impure lates being, on the whole, slightly earlier than the pure lates. As a result of this relation the range of flowering of late plants of " segregating " families became greater than that of the late plants of 'pure' families in F_3 and later generations.

The genetics of the crosses have been explained on the assumption that three factors, one from the early types and two from the late types, interact in inheritance and cause the segregations observed.

Correlations between flowering duration and yield per plant, yield per ear, weight of five ears, number of tillers per plant have been described. (*Authors' abstract*).

Single value soil properties: Moisture at the Sticky Point and *R*.

J. CHARLTON. (*Ind. J. Agric. Sci.*, **6**, 1,054).

USING thirty-eight soils specially chosen to cover wide ranges in texture, *p*H, carbonate content, etc., the effect of variation in content of organic matter, base exchange capacity, clay, carbonates, combined water and $\frac{SiO_2}{R_2O_3}$ (molecular) in the clay fraction on moisture at the Sticky Point and R was examined, first with original (untreated) soils, secondly with only one replaceable base (calcium) present and thirdly after removal of humified organic matter with cold NaBrO solution. In the last case also calcium was the only replaceable base present.

When calcium was the only replaceable base present in the soils, the loss on ignition was found to be the most important parameter controlling the moisture at the Sticky Point, while $\frac{SiO_2}{R_2O_3}$ also exercised a relatively small influence. Provided that the soil was not too sandy and not of an extreme $\frac{SiO_2}{R_2O_3}$ ratio, it was found that the moisture at the Sticky Point could be calculated with fair accuracy from the equation :—

$$SP = 2 \cdot 637 \text{ L. I} + 23 \cdot 98.$$

if calcium was the only replaceable base present and humified organic matter was not removed. Since determination of loss on ignition is susceptible of better control than moisture at the Sticky Point, the former is preferred.

R appears to be uninfluenced by organic matter although like moisture at the Sticky Point, it is largely controlled by combined water. In the case of R, however, the base exchange capacity exercises a significant influence while the presence of carbonates and variations in the $\frac{SiO_2}{R_2O_3}$ ratio are too important to be ignored. It is possible that the lack of precision in determination of certain of the parameters may obscure the relationships of R and further examination of this value is necessary. (*Author's abstract*).

The treatment of bovine nasal schistosomiasis. M. Anantnarayan Rao and S. Vaidyanatha Mudaliar. (*Ind. J. Vety. Sci. and Anim. Husb.*, **6**, 332).

Very meagre information is available on the effective treatment of bovine nasal schistosomiasis and hence experiments were conducted with these three drugs :—(1) Antimonium tartaratum, (2) Antimosan and (3) Trypaflavine. Animals suffering from the disease, naturally contracted and of varying durations and intensity were selected and treated with these drugs. Antimonium tartaratum and Antimosan were administered intravenously while Trypaflavine was given orally as well as intravenously. The result of experimental treatment in each case has been recorded below :—

(1) *Antimony tartarate.*—Four diseased animals were treated with this drug. One received 1·5 grs. per 100 lb. body weight daily for 6 days and was cured completely in 6 weeks' time which fact was ascertained by examination of the nasal discharge for ova and later by destroying the animal and making a careful *post mortem* examination.

The second animal was given 3 grs. for 100 lb. body weight every fourth day for 4 days in the course of 2 weeks. The animal was observed for 5 months and was found cured.

The third and the fourth animals were given the drug in doses of 4 grs. and 5 grs. per 100 lb. body weight respectively. The former was given a second injection of the same dose after a week's interval and it died in 12 hrs. after this second injection. The other died within 36 hours after the primary injection. *Post mortem* examinations in these two cases revealed a large number of schistosomes in both the nasal veins and in the blood clots in the heart, and pulmonary arteries.

(2) *Antimosan.*—Four animals were used for experiments with this drug. In one, a dose of 2 c. c. per 100 lb. body weight on alternate days was given intravenously till 4 injections were administered ; in the second, a dose of 5 c. c. per 100 lb. body weight twice a week till 4 injections were given, was administered. In the third 7 c. c. per 100 lb. body weight was given and only two doses were administered at an interval of a week. In the fourth animal, the dose of the drug given was 7½ c. c. per 100 lb. body weight every alternate day till 3 doses were given. In all these cases, improvement was observed in the early stages, but only that which received larger doses was cured.

(3) *Trypaflavine.*—Three animals were treated with this drug and it was found to have no curative effect.

The summary of the experimental treatment is as follows :—

(*a*) Antimonium tartaratum, Antimosan and Trypaflavine were given a trial in treating cases of bovine nasal schistosomiasis.

(*b*) Trypaflavine was found to be useless. Antimosan appears to be safe and effective if given according to the instructions of the makers in large doses—but expensive.

(*c*) Antimonium tartaratum is effective and cheap. The dose recommended is 1·5 grs. for every 100 lb. body weight repeated daily for 6 days or 2·5 grs. every alternate day for a week.

(*d*) Any dose exceeding 3·5 grs. per 100 lb. body weight seems to be dangerous particularly when repeated. (*Authors' abstract*).

Some notes on the cutaneous myiasis in animals in the Madras Presidency. M. ANANTNARAYAN RAO and M. RAMAKRISHNA PILLAY. (*Ind. J. Vety. Sci. & Anim. Husb.*, **6**, 261).

CUTANEOUS myiasis or fly-blown sores is very common in animals in this country but apparently it has not received much attention. The work by Patton on this subject is probably the only record that is available at present. With a view to study this condition in its varied aspects, such as seasonal incidence, endemicity, animals affected and other materials, in the form of larvae, were obtained from the wounds of different animals from the districts. From the study made so far the following conclusions have been arrived at :—

Chrysomia bezziana is the commonest fly responsible for cutaneous myiasis and *Lucilia argyricephala* may cause fly-blown wounds in a very few cases. *Lucilia sericata* ("Sheep maggot" fly) appears to be non-existant in this Presidency.

C. bezziana is purely obligatory while *L. argyricephala* breeds in dead meat usually.

Bovines and buffaloes are affected in larger numbers than other species.

The skin and mucous membranes of animals are more prone to be fly blown than other parts of the body.

The incidence of this condition seems to be more in wet than in dry areas and that during the cooler months of the year.

The presence of maggots of *C. bezziana* in the sores of fowls and sheep is recorded.

Presence of pupae of *Musca nebulo* in the fresh faeces passed by a horse is recorded. (*Authors' abstract*).

Studies on the diphtheritic form of fowl pox in India. R. L. KAURA and S. GANAPATHY IYER. (*Ind. J. Vety. Sci. & Anim. Husb.*, **6**, 313).

A SURVEY of the past work on fowl pox and several other allied conditions, now known to be etiologically one and the same, has been made.

Experimental transmission of diphtheritic lesions from the mouth of fowls has confirmed that the causal agent, a filtrable virus, is the same as that which produces fowl pox lesions on the skin in India.

The Indian strain of fowl pox virus is immunologically indistinguishable from the Weybridge strain.

There seems to be a tendency for generalisation with this particular strain of the virus (obtained from Cannanore, Madras) although this has not been seen in the case of specimens received from other provinces in India, so far.

Filtration experiments have been conducted with this strain of the virus and Berkfeld 'V' filtrate has given positive results unlike Chamberland L. 3 and Berkfeld 'N' filtrates. (*Authors' abstract*).

NOTES

AN INDEX OF THE MINOR FOREST PRODUCTS OF THE BRITISH EMPIRE*

HARDLY a day passes without news concerning the production or regulation of supply of some staple commodity such as wheat, milk, or tin. Meanwhile trade still goes on in a host of lesser products of which little is heard and about which information is difficult to procure. The forests of the world have always been a great source of such products. Some of them, such as rubber, cinchona and the oil palm have advanced from the stage of minor products of the forest to regularly cultivated crops. Similar changes may occur again, but all the time, trade in a number of comparatively little known products (some of it international, some of it only local) still goes on.

An Index to these minor products of the forests of the British Empire, compiled by the Imperial Economic Committee in consultation with the forest departments of the Empire and with the assistance of Kew and the Imperial Institute, has just been published.* The Index is the first of its kind. In it the various minor forest products (defined as any product of the natural forest other than timber and its derivatives) are classified under drugs and spices, dyes, essential oils, fibres, gums and resins, oils and oilseeds, tanning materials, and miscellaneous products. These sections, each prefaced by a short introduction, give for each commodity the trade name, the botanical species and the country of origin, and indicate whether an export trade has already been established, and, where it has not, whether in the opinion of local officers, the economic possibilities are favourable or slight. References are also given to a select bibliography from which more detailed information can be obtained.

Some 580 products and over 500 species have been listed from 36 countries in the Empire, and over 400 bibliographical references are given. Such a compilation should be useful to merchants, forest officers and administrators, by providing them with immediate information in a handy form and directing them to the chief sources of information on specific products, while it may also be helpful to forest officers when considering the economic possibilities of some product of the forest as yet unused.

The only surprising thing is that it has not been done before.

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* An Index of the Minor Forest Products of the British Empire: printed and published for the Imperial Economic Committee by H. M. Stationery Office, price 5*s.* 0*d.* net; 5*s.* 3*d.* post free.

NUTRITION AND AGRICULTURE

The following communication was issued by the Press Bureau of the International Institute of Agriculture, Villa Umberto, Rome, in August 1936 :—

Further discussions on the subject of improved nutrition standards, which promise to be highly interesting and important, will take place in October next on the occasion of the XIII General Assembly of the International Institute of Agriculture of Rome. Certain special studies of this question have been made recently by the League of Nations and by the International Labour Office, in collaboration with the Institute, which has provided both institutions with an ample statistical documentation. A highly informative report has also been prepared for the Assembly by Mr. McDougall, Delegate of Australia on the Permanent Committee of the Institute. A brief summary of this Report is given in the following paragraphs :—

> The writer shows in the first place that a satisfactory human dietary must be based on an adequate consumption of the " protective " foods, which include milk, cheese, butter and other dairy products, fresh fruit and vegetables, eggs, fish and meat. Unfortunately the special studies and statistics which deal with the subject show that the great masses of the population throughout the world do not consume these particular foods in sufficient quantities. The result is frequently the appearance of " deficiency diseases " such as pellagra and beri-beri, and also, especially in the child population, dental troubles, bone malformation, rickets and a general sub-normal physique.

> After having demonstrated the benefits that would accrue to human welfare through the raising of nutrition standards and directing attention to the growing tendency of public opinion to make the State responsible for the supervision of national nutrition, Mr. McDougall considers the effects of such improved standards on agriculture. Consumption of the " protective " foods might go far to cause a revival in the trade in food products. If practical steps were taken to bring about a rise in consumption, particularly as regards these particular foods, it would be possible for the industrial countries to concentrate their attention on producing larger quantities of the more perishable foods, and the production of the chief world agricultural staples, such as wheat and sugar, might be left to a greater extent to the great low-cost exporting countries.

Thus the way would be opened for a general recovery in world trade with beneficial effects, not only upon the economic situation, but also on political relations in all countries.

The writer then considers the different methods of improving nutrition, after stating that malnutrition is due in the first place to poverty and in the second to ignorance.

In reference to the first of these factors, he instances certain of the more important suggestions that have been offered. These include: the distribution of milk and/or other food, either free or below cost, to pregnant and nursing mothers, to children below school age and to children at school; the lowering of the margin between wholesale and retail prices where unduly high; differential prices for certain social groups. Further more subsidies, now granted to producers, might in certain cases be utilised as subsidies to consumption.

In regard to the matter of ignorance, the writer considers that the newer methods of popular education, such as broadcasting, the talking film, etc., might be adopted with advantage.

Mr. McDougall lays stress on the value of adequate credit provision, if agriculture is to be called upon to readjust and intensify production. He considers that the idea of an International Agricultural Mortgage Bank, capable of assisting the Governments to turn over to the production of the most economic and health promoting foods, might now be revived with better hope of success. The great creditor nations would be the more willing to give their support, since they would see that their own economic interests would stand to gain by the operation of the proposed Bank.

Herein, in the view of Mr. McDougall, there may be found a solution of the hotly debated problem of agricultural protectionism. There can be no doubt that the solution of the questions discussed by the writer of this report might contribute in no small degree to a revival in world prosperity.

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THE GENERAL ASSEMBLY OF THE INTERNATIONAL INSTITUTE OF AGRICULTURE

The following communication was issued by the Press Bureau of the International Institute of Agriculture, Villa Umberto, Rome, in August 1936 :—

The Permanent Committee of the International Institute of Agriculture of Rome has already established the outline of the agenda for the Institute's XIII General Assembly, of which the meetings will begin on the 5th of October. The General Assembly of the Institute brings together in Rome every two years for a period of a week or more the Delegates of all the member States The Assembly passes in review the work, activities and policies of the Institute during the period since its last meeting, and also indicates the general lines on which this work

shall be continued, while at the same time it considers, from the international point of view, the more important questions of the day as affecting agriculture and farmers.

The discussions of the Assembly never fail to arouse the interest of scientists, students, technicians, etc , engaged in the study of the various aspects of the problems of agriculture.

The forthcoming General Assembly will like its predecessors, consider in the first place the Statement of the President, the Report of the Secretary General on the work of the different departments and on the administration and the Report on the financial situation which will be submitted this year by Mr. Koehler, the Delegate of Germany. A report will be presented by Mr. Marquis, the Delegate of the United States of America, on the subject of: "International agricultural collaboration in relation to the prosperity of the Nations".

In this Report, Mr. Marquis indicates clearly the place that the Institute should occupy in international collaboration—as between States and Institutions—for promoting the progress of agriculture. Thus the General Assembly will have the opportunity of considering in all its aspects the important and far-reaching problem of the organization on international lines of the special studies, investigations and action taken by State and independent organs on behalf of agriculture and the farmer. Such action, investigations and special studies will find a valuable focussing point in a duly authorised centre, which, without exercising any form of restrictive influence, is in a position to direct and assist the general movement.

Such a centre is naturally to be found in the International Institute of Agriculture.

Mr. J. F. Radcliffe, Delegate of the Irish Free State, will present in the name of the Permanent Committee, a Report on organization and staff questions.

Another question to be discussed at the meeting on the motion of Mr. McDougall, Delegate of Australia, is that of "Nutrition and Agriculture".

By including this burning question in the items of the Agenda of the General Assembly, the Institute has evinced its desire to submit an essential problem, with which it must perforce concern itself, to consideration by so important an international re-union of recognised authorities, representing the world of agriculture. The Institute's own Services, on the request of the *Mixed Commission on Nutrition* of the League of Nations has already initiated its own investigation of the question and has undertaken a series of special studies on the production and consumption of several food products. The Institute is also collaborating with the International Labour Office in the preparation of a section of a Report on "Nutrition and Social Policy". Its work on the subject is therefore destined in

part to the Assembly of the League and in part to the International Labour Conference.

The General Assembly of the Institute is now invited, on the basis of a striking Report, presented by Mr. McDougall, to discuss the problem as a whole as regards its various aspects and repercussions, and more particularly from the point of view of agricultural economy.

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WORLD TRADE IN SHELL EGGS IN THE LAST SIX YEARS

THE following communication has been received from the Press Bureau of the International Institute of Agriculture, Villa Umberto, Rome :—

In the July number of its *Monthly Crop Report* the International Institute of Agriculture publishes a survey of the trends of international trade in eggs in the shell during the years 1930 to 1935 and in the first quarter of 1936. This study is based on the statistics of exports from the 17 chief exporting countries and on those of imports into the 8 chief importing countries.

The most striking feature revealed by the trade movements of these two groups of countries is a continuous decline in the volume of the egg trade from 1930 to 1935. Exports in 1935 from the 17 countries in question amounted to 270,000 metric tons as compared with 220,000 metric tons in 1934 and an average of 410,000 metric tons in the four years 1930 to 1933. The decline from these years was equivalent to 6 per cent and 33 per cent respectively.

Of the 17 exporting countries, Denmark the largest, and French Morocco only exported more than they did in 1934 and in the previous four years. The exports of France and Poland, though larger than in 1934, were considerably below the average.

The exports of all the other countries were below those of 1934 and also below the average. The U. S. S. R. in 1931 exported 20,400 metric tons but in 1935 its sales abroad had fallen almost to zero. Substantial declines were registered also in Egypt and Turkey.

Great Britain and Northern Ireland, the largest importing country in the world, and Czechoslovakia increased their imports but the remaining six importing countries all took smaller quantities. British imports in the years 1930 to 1935 were lowest in 1933 at 138,000 metric tons. They subsequently increased slowly, reaching 141,000 tons in 1934 and 148,000 tons in 1935. Germany, the second largest importer, has reduced its imports considerably. Its purchases in 1935 amounted to only 85 per cent of the 1934 figures and to about half the average of the years 1930 to 1933.

The substantial decrease in the world egg trade is to be attributed mainly to the efforts of the importing countries to reduce their dependence on foreign supplies.

The returns for the first quarter of 1936, however, suggest that a slight recovery is taking place.

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THE AREA AND DISTRIBUTION OF VINES

The following communication has been received from the Press Bureau of the International Institute of Agriculture, Villa Umberto, Rome.

Although there are still some gaps in the statistics of the viticultural industry, the International Institute of Agriculture has prepared the following summary of the present world situation.

The feature that first leaps to the eye is, of course, the expansion that has occurred in vine growing in recent years. The increase in the area covered by vines in 1934-35 was as much as 15 per cent compared with 1926-27, the total world area of vineyards in 1934-35 reaching about 20,500,000 acres of which 17,500,000 acres were in Europe, Russia and North Africa.

Ninety-four per cent of this area consisted of bearing vineyards, representing a productive area of 19,300,000 acres. 2,700,000 acres consisted of vineyards producing table grapes and grapes for drying. The vines mainly grown for the production of wine covered 86 per cent of the total area in production in 1934-35.

A relatively great expansion has occurred in recent years in the production of table and dried grapes. The area devoted specially to this branch of production in 1934-35 was 20 per cent greater than the average area of the period 1926-27 to 1930-31, notwithstanding a considerable decline revealed by the official statistics of the United States. The cultivation of table grapes has made great strides both in the Near East and in most European countries, particularly France, Spain, Romania, Greece, Italy, Bulgaria and Czechoslovakia.

The increase in vines destined for wine production is small in comparison since in 1934-35 it was hardly 8 to 9 per cent of the average area of the period 1926-27 to 1930-31. In addition to the expansion in area, however, it is to be remembered that a considerable proportion of vines have been recently replaced by young, high bearing plants better suited to resist cryptogamic disease, a development which quite apart from the larger area, has helped materially to raise the average yield per acre.

The growth in the vine area now appears to be coming to an end. Some plantations, however, are not yet producing and the bearing area in 1935-36 appears to be still a little larger. Moreover, it is estimated that about 2,500,000 acres of new vineyards have been planted since 1930 and will reach a stage of full production in 1936. The International Institute of Agriculture thus estimates that, provided that the area eliminated will not be of large dimensions, world production will show a further slight increase. In the five years 1926-27 to 1930-31 world wine production averaged 3,960 million Imperial gallons and it increased

to 4,300 million gallons in the quinquennium 1931-32 to 1935-36. In the future it is likely to reach 4,600 million gallons on the average though the production of individual years may be greater or smaller than this figure by as much as 400 million gallons.

This conclusion and the preceding outline of the statistical position of world viticulture are based on the information contained in the tables of the latest edition of the International Yearbook of Agricultural Statistics which will be published in a few days.

MOLASSES, NITROGEN FIXATION AND LAND RECLAMATION*

In his Presidential address to the United Provinces Academy of Sciences, India, on December 19, 1935, Prof. N. R. Dhar gave a general account of the work carried out by himself and his collaborators on nitrogen transformations in soil. Prof. Dhar leads the school of thought which believes that nitrification in soils and nitrogen fixation from the atmosphere are, especially in the tropics, photochemical at least as much as bacterial actions. Prof. Dhar has produced strong evidence in support of his theories, and the question appears now to have reached the stage at which the protagonists of bacterial and photochemical nitrification respectively are unwilling to admit any evidence which might shatter their beliefs.

Meanwhile, other soil workers will be wise to keep an open mind on the matter, for the philosophical implications of recognising that light plays a part in soils analogous to photosynthesis in the vegetable kingdom are at least as important as the practical possibilities of utilising that knowledge for the enrichment of the soil. Given sufficient facts, their practical application does not necessarily depend on their correct interpretation. The practical facts of Prof. Dhar's researches are that Indian soils are generally deficient in nitrogen, that more than half a million tons of molasses from the sugar industry are annually wasted in India, and that the application of molasses to the soil can double and may treble the soil nitrogen content, with a consequent large increase in crop yield.

Molasses contains about 70 per cent of carbohydrates and small quantities of nitrogen, phosphorus, potash, etc., these quantities, however, being much too small to account for the observed manurial effect. According to Prof. Dhar, the energy set free in the oxidation of the sugars in molasses is utilised, either bacterially or photochemically, in promoting nitrogen fixation and nitrification. Whatever the nature of the process, Dhar has produced indisputable evidence of increases in available soil nitrogen and crop yields following the application of molasses. Under temperate conditions, the converse result would be expected,

*Reproduced from *Nature*, April 11, 1936, p. 629.

as it is well known that the addition of carbohydrate-rich material to soil tends to reduce the amount of nitrogen available to plants, the nitrogen becoming fixed as microbial protoplasm or as humus. An essential difference, however, between temperate and tropical soil requirements is that, whereas in temperate regions the limiting factor to crop growth is often the slowness, in the tropics it is the rapidity with which soil nitrogen is made available to plants, soluble nitrates being formed and leached from the soil before they can be absorbed by the crop. The general effect of molasses on the soil should be the same everywhere, but only in the tropics will its " braking " effect on the mobilization of soil nitrogen be a positive advantage to the cultivator, and only in the tropics will its stimulation of atmospheric nitrogen fixation, whether bacterial or photochemical, be appreciable, since temperate regions lack the heat necessary for bacterial and the light for photochemical stimulation.

For these reasons, the potentialities of carbohydrate manuring—of which molasses manuring is an example—have perhaps been overlooked by agriculturists. If Prof. Dhar can substantiate his claims, he may effect a revolution in agriculture in India, where the supply of the ordinary organic manures is far below the demand. Prof. Dhar suggests that a most valuable use can be made of molasses in reclaiming alkaline land. The acids produced in the decomposition of molasses neutralise the alkalis, and at the same time and contrary to experience when land is reclaimed with gypsum or sulphur, soil nitrogen is increased.

A period of about four years is usually necessary to reclaim alkali land with gypsum, whereas with molasses applied at a rate of 30-40 tons per acre, good crops can be grown within six months. It is not stated whether such reclamations have been found permanent—in view of the oxidisability of the neutralising acids, this is open to doubt—but the method obviously merits further study. There are four million acres of infertile alkali land in India, and irrigation practices are increasing the area. The economic reclamation of these lands is one of the country's greatest agricultural problems, to the solution of which Prof. Dhar's work is pointing the way.

PLANT QUARANTINE AND OTHER OFFICIAL ANNOUNCEMENTS

PORTUGAL

PLANT QUARANTINE IMPORT RESTRICTIONS OF THE REPUBLIC OF PORTUGAL

BASIC LEGISLATION

Decree No. 12740, Nov. 26, 1926, article 2, paragraph 2

Decree No. 15331, Apr. 9, 1928, article 1

SUMMARY.

Importation prohibited

ELMS (*Ulmus* spp.) from any source: Importation prohibited to prevent the introduction of the Dutch elm disease (*Graphium Ulmi* Schwarz). (Decree No. 22389, March 29, 1933, art. 5, p. 3.)

Potatoes (*Solanum tuberosum* L.) from America: Importation prohibited to prevent the introduction of the Colorado potato beetle (*Leptinotarsa decemlineata* Say.). (Decree No. 20535, Nov. 20, 1931, art. 2, p. 5.)

Potatoes from the Island of Madeira: Importation into the Azores prohibited to prevent the introduction of *Bacterium solanacearum* E. F. Sm., bacterial wilt. (Decree No. 22389, Mar. 29, 1933, art. 6, p. 5.)

Importation restricted

Living plants or parts thereof for propagation from extra-European countries: Importation subject to a previous authorization from the Direccao Geral dos Servicos Agricolas. Phytosanitary certificate of competent authority required with each shipment. (Decree No. 22389, Mar. 29, 1933, arts. 2 and 3, p. 2). See paragraphs (*a*) to (*g*) of article 3 for special certification for certain groups of plant material.

Seeds of horticultural, field, or forest plants, from any country, or living plants or parts thereof for propagation from any European country: May be imported without a previous authorization, if accompanied by a phytosanitary certificate of competent authority of the country of origin. (Decree No. 22389, Mar. 29, 1933, arts. 1 and 3, pp. 2 & 3).

Fruits from any source: Importation into continental or insular Portugal subject to inspection on arrival especially for scale insects, San Jose scale in particular. (Decree No. 22389, Mar. 29, 1933, art. 9, p. 4.)

Potatoes from sources other than America: Phytosanitary certificate of competent authority of country of origin affirming freedom of the source from potato wart [*Synchytrium endobioticum* (Schilb.) Perc.], and Colorado potato beetle (*Leptinotarsa decemlineata* Say.). (Decree No. 20535, Nov. 20, 1931, art. 3, p. 5.)

General Regulations

Decree No. 22389, Mar. 29, 1933; Diario do Governo, 1:75, Apr. 1, 1933, pp. 447-449

Plant material not subject to an import authorization

Article 1. The importation is permitted from European or extra-European countries, without previous authorization, of seeds of horticultural, field, and forest plants, and of living plants and parts thereof for propagation (stocks, wild plants, scions, rhizomes, bulbs, tubers) from European countries, except those mentioned in articles 5 and 6.

Plant material subject to special import authorization

Article 2. The importation into the mainland or the adjacent islands of living plants or parts thereof for propagation (stocks, cuttings, scions, rhizomes, tubers, and bulbs) from extra-European countries, whether or not those countries belong to Portugal, except the adjacent islands, is subject to a special authorization of the Direccao Geral dos Servicos Agricolas.

Phytosanitary certificate required

Article 3. Shipments of living plants, or parts of living plants, intended for propagation must be accompanied by phytosanitary certificates indicating origin, issued by authorities of the official phytosanitary inspection service of the country of origin. These must indicate the names of shippers and consignees, the exact description of the goods, marks, quantity, weight, and phytosanitary condition and, in particular, with respect to:

(*a*) Alfalfa (*Medicago sativa* L.), a declaration that they are free from dodder seeds (*Cuscuta trifolii*, *C. gronowii*, *C. Suaveolens*, etc.).

(*b*) Beans (*Vicia faba* L.) and peas (*Pisum sativum* L. and *Lathyrus odoratus* L.), a declaration of freedom from broom-rape seed (*Orobanche crenata*, *O. minor*, etc.).

(*c*) Rooted plants, cuttings, bulbs, tubers, rootstocks, and other parts of plants that have been in contact with soil; a declaration that they were grown in ground free from potato wart [*Synchytrium endobioticum* (Schilb.) Perc.] and located at least 5 km. from any focus of that disease.

(*d*) Rooted pear trees, cuttings, scions or buds, the same declaration as in (*c*); also that in the locality of growth fire blight [*Bacillus amylovorus* (Burr.) Trev.] does not occur.

(*e*) Rooted chestnut trees (*Castanea* spp.), scions, or buds, in addition to the declaration of paragraph (*c*), another to the effect that chestnut canker [*Endothia parasitica* (Mur.) And. and And.] does not occur in the locality in which the trees were grown, and that no planting or grove of chestnut trees attacked by the ink

disease [*Phytophthora cambivora* (Petri) Buis] exists within at least 5 km. of the place of growth.

(*f*) Grapevines, cuttings, or scions, in addition to declaration (*c*) one to the effect that the material proceeded from vines free from the virus disease known in France as " court-nous ".

(*g*) Potatoes, tomatoes, and eggplants (*Solanum tuberosum*, *Lycopersium esculentum*, and *Solanum melongena*) all the data prescribed by Decree No. 20535 of November 20, 1931 and the regulations approved by Decree No. 21172 of April 27, 1932.

Plants must be free from soil

Article 4. Rooted plants, bulbs, rhizomes, and tubers, must be free from earth, and, according to the case, be packed in sphagnum moss, or pent.

Article 5. The importation of elms (*Ulmus* spp.) is prohibited.

Article 6. The importation into the Azores of potatoes from Madeira is prohibited.

All imported plant material subject to inspection

Article 7. All plants or parts of plants imported into continental or insular Portugal for propagation are subject to inspection.

Authorized ports of entry

(1) Inspection is effected in the customs offices of Lisbon, Oporto, Ponta-Delgada, Horta, Angra do Heroismo, and Funchal.

(2) Seeds of plants, except alfalfa, pea and bean seeds, are free from inspection.

(3) Exceptionally, the entry of plants may be effected at customs offices other than those above named on permission of the Direction-General of Customs at the request of the Direction-General of Agriculture, which will send one or more inspectors to make the necessary inspection.

(4) The merchandise will be delivered to the consignee only after he has presented to the customs the duplicate of the phytosanitary certificate issued by the Chief of the Division of Phytopathological Inspection, or by one of the officials referred to in this article.

Fumigation may be required on arrival

Article 8. All plants, and especially apple, orange, olive, and other fruit trees, must be fumigated by the phytopathological inspection service before delivery to the consignee, provided that the inspectors deem it necessary.

Fruits inspected for scale

Article 9. Fruits imported into the mainland or the adjacent islands will be inspected in customs offices and released only when found entirely free from exotic coccids, and especially from San Jose scale (*Aspidiotus perniciosus* Comst.).

Potato import restrictions

(Decree No. 20535, Nov. 20, 1931 ; Diario do Governo 1 serie, No. 268, Nov. 20, 1931.)

Article 1. The importation of potatoes into continental Portugal and the adjacent islands (Azores and Madeira) is permitted only when the potatoes originate in and proceed from a country possessing properly organized phytopathological services.

Importation of American potatoes prohibited

Article 2. The importation of American potatoes is expressly prohibited through any port of continental Portugal or the adjacent islands.

Article 3. Shipments of potatoes from other countries must be accompanied by an inspection certificate affirming freedom of place of growth from potato wart and Colorado potato beetle.

Since potatoes may not be imported from the United States into Portugal the remaining regulations under this decree are omitted.

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GRENADA

PLANT QUARANTINE IMPORT RESTRICTIONS OF THE COLONY OF GRENADA, B. W. I.
BASIC LEGISLATION

The Plant Quarantine Ordinance of June 1, 1906 (No. 7 of 1906)
The Noxious Weeds Ordinance of March 23, 1912 (No. 2 of 1912)

SUMMARY*

Importation prohibited

*COCONUT plants (*Cocos nucifera* L.): Importation into the Colony prohibited from any place out of the Colony, to prevent the introduction of the red ring disease (*Aphelenchus cocophilus* Cobb). (Proclamation of April 4, 1919, p. 4.)

Sugarcanes and sugarcane plants (*Saccharum officinarum* L.) : Importation from Barbados, directly or indirectly, prohibited (except with the special sanction of the Governor in Council) to prevent the introduction of the mosaic or yellow mottling disease. (Proc. of Jan. 5, 1921).

Sugarcanes and sugarcane plants (*Saccharum officinarum* L.) from Trinidad, B. W. I. : Importation prohibited of all varieties except the Uba sugarcane plant when imported by the Agricultural Department of Grenada, to prevent the introduction of the mosaic or yellow mottling disease. (Proc. of May 30, 1924).

*Bannana plants (suckers), *Musa* spp., from all places except the Leeward Islands (Anguilla, Antigua, Barbuda, Dominica, Montserrat, Nevis, Redonda,

St. Kitts, and the Virgin Isles, B. W. I.), St. Vincent and Barbados: Importation prohibited to prevent the introduction of the Panama wilt disease (*Fusarium cuvense* E. F. Sm.). (Proc. of Dec. 14, 1922, p. 4.)

Cacao plants (*Theobroma cacao* L.), parts thereof, and cacao beans from Trinidad, B. W. I.: Importation, directly or indirectly, prohibited to prevent the introduction of the Surinam witchesbroom disease (*Marasmius perniciosus* Stahel.) (Proc. of Oct. 24, 1928.)

*All succulent fruits (including apple, apricot, cherry, citrus, grape, guava, mango, nectarine, peach, pear, and plum): Importation prohibited from Africa, America (Central and South), Australia, Azores, Bahamas, Bermuda, Cape Verde, France, Greece, *Hawaii*, Italy, Madeira, Malta, Palestine, Spain, and Turkey, to prevent the introduction of the Mediterranean fruit fly (*Ceratitis capitata* Wied).

The importation of such fruits from countries other than those above named is prohibited unless each shipment is accompanied by a *certificate of origin* affirming that the fruit was not grown in any area infested by the Mediterranean fruit fly and that it did not pass through any area so infested. (Proc. of Sept. 10, 1930, as amended by the Proc. of Feb. 8, 1932.)

Importation restricted

*Coconuts in the husk (*Cocos nucifera* L.) imported into Grenada are subject to immediate treatment with efficient fungicides and to planting under quarantine conditions; then to be kept under observation by the Superintendent of Agriculture. Any resulting plants suspected of disease may be destroyed. (Proc. of Apl. 14, 1919, p. 4.)

Cotton seed and seed cotton: Importation from St. Vincent, B. W. I. prohibited, except under license given by the Governor or the Superintendent of Agriculture and subject to the provisions and conditions of such license (Proc. of Feb. 4, 1924.)

*Lime plants (*Citrus aurantifolia* Swingle), and parts thereof, including the fruits: Importation prohibited from all countries and places, except with the special sanction of the Governor in Council, to prevent the introduction of withertip disease (*Gloeosporium limetticolum* Clausen). (Proc. of July 1, 1925, p. 4.)

Plant protection ordinance

(June 1, 1906)

As defined by this ordinance "Plants" includes growing plants, cuttings, buds, and grafts, bulbs, roots, seeds, and berries, also fruits, and vegetables; "port

*Items indicated by an asterisk concern the United States. Except as thus indicated, there are no restrictions upon the entry into Grenada of plants and plant products of the United States and no phytosanitary inspection certificate is prescribed.

of entry " means the port of St. George's and any other port or place in the Colony designated by the Governor for the importation of plants.

The ordinance empowers the Governor in Council, by proclamation, to prohibit or to restrict the importation of plants as above defined, either generally or with respect to any country or place. He is also authorized to seize prohibited "plants" offered for entry into the Colony; to apply such treatment to imported "plants" as may be deemed necessary at the expense of the importer and to make rules and regulations for carrying out the provisions and intentions of the Ordinance.

Noxious weeds ordinance

(Mar. 23, 1912)

This ordinance empowers the Governor, with the consent of the Legislative Council, to make, modify or revoke regulations to prevent the introduction into the Colony, or the sale of any plant, seed, or grain that is likely to propagate or spread the growth of noxious weeds.

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NEW CALEDONIA

PLANT QUARANTINE IMPORT RESTRICTIONS OF THE FRENCH COLONY OF NEW CALEDONIA

(Including the Futuna, Alofi, Huan, Loyalty, and Wallis Islands and the Isle of Pines.)

Governor's Decree No. 103 C, January 27, 1934

Importation restricted

ARTICLE 1. The importaton into New Caledonia and its Dependencies of root, seeds, flower bulbs, earth, and vegetable manures, and other similar goods, as well as packing materials that have served for their transportation, is subject to the following restrictions :

Phytosanitary certificate required

Article 2. The products named in the preceding article must be accompanied by a shipper's declaration and a certificate issued by the competent authority of the place of origin, and in certain cases visaed by the consular anthority, wherein it is stated that in the country of origin no injurious diseases or parasites are present in the kinds of products imported.

Disinfection may be required

Article 3. The imported products, in order to be admitted into the Colony, without reference to their origin, may be subjected to disinfection, for which the Administration of the Colony will establish regulations.

All imported plants, grains, or products which on arrival are found to be infected or attacked by parasites, must be destroyed at the expense of the importers.

Entry unrestricted

Article 4. Agricultural and horticultural products, kitchen vegetables, grains, and fruits intended for consumption are free from the preceding provisions.

Article 5. Seeds intended for food purposes are not subject to any special regulation.

Importation prohibited

Article 6. The importation of coconuts, seed hulls of coconut palms, and basket-making goods of coconut palm leaves that originate outside the Archipelago of New Caledonia and the Loyalty Islands, into New Caledonia and its Dependencies is absolutely prohibited. Every product of this kind that is seized on arrival in Noumea shall be destroyed by burning.

Potatoes must be certified

Article 7. Potatoes will be admitted to entry only when accompanied by a phytosanitary certificate issued by an authorized official of the exporting country and affirming that they were inspected on shipment and were free from any kind of pest.

Tubers found on entry to be infected are to be returned or destroyed.

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SPAIN

PLANT QUARANTINE IMPORT RESTRICTIONS OF THE REPUBLIC OF SPAIN

BASIC LAW

Law on the Extermination of Crop Pests and Protection against the same, May 21, 1908

CONCISE SUMMARY

SINCE the Orders of April 19, 1929 (p. 4) and April 20, 1932 (p. 5) practically constitute an absolute embargo against the importation of plants and fresh plant products from the United States into Spain, reference to those orders alone is necessary, except with respect to the unrestricted material covered by the law of May 21, 1908, articles 22 and 32. (See item under "Importation Unrestricted".)

Importation prohibited

Phylloxera vitifoliae Fitch : Introduction of viable eggs, larvae, and pupae into non-phylloxerated provinces of Spain prohibited unless enclosed in glass vials or tubes hermetically sealed. (Law of May 21, 1908, Art. 27.)

Grapevines and dry stems : Importation into Spain and adjacent islands prohibited. (Law of May 21, 1908, Art. 29.) Trees, shrubs, and plants from countries that do not adhere to the International Phylloxera Convention and are infested with phylloxera may not be imported into non-phylloxerated provinces. (Law of May 21, 1908, Art. 31.)

Chestnut (Castanea spp.) and its products, from China and Japan to prevent the introduction of chestnut canker, *Endothia parasitica* (Murr.) And. & And. (order of Dec. 21, 1922.)

Live plants and parts thereof, including seeds, attacked by injurious parasites.

Live insects injurious to plants, including eggs, larvae, pupae, and nymphs of such insects.

Cultures of bacteria and fungi injurious to plants. Soils or other materials containing parasites injurious to plants when the soils, etc., accompany living plants.

Containers that have served for the transportation of the above-mentioned products : Importation prohibited. (Decree of June 20, 1924, Art. 1.)

Fresh fruits, living plants, and parts thereof, including cuttings, scions, etc., of fruits : Importation prohibited from Argentina, Brazil, Canada, Japan, Mexico, New Zealand, Portugal, United States, and Union of South Africa, to prevent the introduction of the injurious plant pests and diseases named in the order of April 1929, as extended by the decree of August 14, 1934 (see pp. 4 & 5.)

Cotton seed and seed cotton from Brazil, China, Egpyt, India, Japan, Mexico and the United States to prevent the introduction of the boll weevil, *Anthonomus Grandis* Boh., and the pink bollworm, *Pectionophora gossypiella* Saund. (Orders of Apr. 19, 1929, and Nov. 5, 1923, see pp. 4 & 5.)

Coconut fibre. (Decree of Oct. 31, 1931, see p. 7.)

Potatoes, their leaves, stems, and peelings, to prevent the introduction of the Colorado potato beetle, *Leptinotarsa decemlineata* Say., from France, Germany, Poland, and other European countries infested by the Colorado potato beetle. (Order of Nov. 3, 1931.)

Plant parasites against which certification is required. (Order of Aprl. 20, 1932, see pp. 5 *et seq.*)

Banana plants or parts thereof : Importation into the Territory of the Canary Islands of plants or parts thereof, of *Musa* spp. from any source prohibited.

Living plants, straw, and other by-products, and other articles of plant origin, such as trunks, roots, leaves, used supports even though exported from Madeira as fuel as a precaution against the introduction of the banana borer (*Cosmopolites sordidus* Germ.). (Order of May 28, 1934.)

Importation restricted

Phylloxera vitifoliae Fitch, viable eggs, larvae and pupae : Importation and transportation in viable condition permitted into non-phylloxerated provinces only in glass vials or tubes hermetically sealed with sealing wax. (Law of May 21, 1908, Art. 27.)

Grapevines and cuttings thereof, of American species, may be imported into non-phylloxerated provinces only under a special authorization of the respective provincial Agricultural Council. (Law of May 21, 1908 and Order of 31, Dec. 1909, as amended by that of Dec. 14, 1914.)

Trees, shrubs, and plants of all kinds, except grapevines, from countries which do not adhere to the Berne Convention, may be imported into or through non-phylloxerated provinces only when accompanied by a shipper's declaration of origin and a phylloxera certificate. (Law of May 21, 1908, Art. 30, par. 3 ; this applies only to plant material proceeding from countries in which phylloxera does not occur ; Art. 31.)

Cotton seed : Importation and distribution must be passed upon by the State Cotton Commissary. Prohibited from Brazil, China, Egypt, India, Japan, Mexico, and the United States. (Orders of Nov. 5, 1923, and Apr. 19, 1929.)

Ornamentals with a minimum quantity of soil adhering to the roots, admitted from Belgium, France, and the Netherlands under certification. (Orders of Nov. 8, 1929, June 28, 1930, and Nov. 9, 1931.)

Potatoes : Each shipment to be accompanied by a certificate affirming that the tubers were grown in a locality free from potato wart, *Synchytrium endobioticum* (Schilb.) Perc., and that the place is situated not less than 20 km. from any crop attacked by that disease. (Order of June 4, 1928.) Also a prohibition against importation of potatoes from France, Germany, and other countries infested with the Colorado potato beetle, *Leptinotarsa decemlineata* Say. (Order of Nov. 3, 1931.)

Mushroom spawn : Phytosanitary certificate required, affirming that the manure used for growing the spawn was sterilized before being sown, that the sowing was made from a pure culture of mushrooms, and that the product contains no pathogenic organisms injurious to crops. (Order of Nov. 18, 1931, see p. 8.)

Living plants and parts thereof, including seeds, fresh or dried fruits, fresh vegetables, cereals, dried legumes, etc., must be accompanied by a phytosanitary certificate affirming freedom from the parasites named in the Order of April 20, 1932, pp. 5 *et seq.* The Order of March 6, 1929, contains a list of products subject to certification.

Dried fruits imported through Hamburg, when forwarded to Spain, must be accompanied by a copy of the original phytosanitary certificate and by a new one issued by the phytopathological officials of the port of Hamburg. (Order of May 16, 1933, see p. 7.)

Importation unrestricted

Seeds, dried plants properly prepared for herbariums, cut flowers, and products other than grapevines (Art. 22, Law of May 21, 1908) may enter Spain without other restrictions than those resulting from measures to prevent the spread of diseases other than phylloxera, except as provided in article 30 (Law of May 21, 1908, Art. 32.)

Precautions against the Introduction of Specified Parasites

(*Royal Order No. 976, of Apr. 19, 1929 ; Gaceta de Madrid, No. 114, Apr. 24, 1929*)

Importation prohibited

Article 1. From April 25, 1929, in order to prevent the introduction into Spain of the plant parasites later specified, the importation of products originating in the following-named countries is prohibited :

Japan, United States of America, Canada, and New Zealand. All kinds of fresh fruits, and the plants, shoots, scions, etc., of all fruits, and mulberry trees, as a protection against the insect pests :

Aspidiotus perniciosus Comst., the San Jose scale.

Aulacaspis pentagona Targ., white peach scale.

Dialeurodes citri Riley & Howard, citrus whitefly.

Popillia japonica Newm., Japanese beetle.

And against the cryptogams :

Bacillus amylovorus (Burr.) Trev., fire blight or pear blight.

Phyllosticta solitaria E. & E., apple blotch.

Bacterium citri Hasse, citrus canker.

Brazil, China, Egypt, *India*, Japan, Mexico, and the United States of America. Seed cotton and cotton seed, the cultures of which are attacked by the cotton boll weevil, *Anthonomus grandis* Boh., and the pink bollworm, *Pectinophora gossypiella* Saund. (See also Order of Nov. 5, 1923, restricting the entry of cotton seed.)

Extension of the Prohibition

(*Decree of Aug. 14, 1934 ; Gaceta de Madrid, No. 228, Aug. 16, 1934*)

Article 1. As a preventive measure against the introduction into, transit through, and distribution of San Jose scale, *Aspidiotus perniciosus* Comst., in Spain, the importation is prohibited of all kinds of fresh fruits, as well as living plants and parts thereof (scions, buds, greenhouse plants, etc.), which originate in, or proceed from Argentina, Brazil, Mexico, Portugal, and South Africa.

(Note.—Since the San Jose scale is widely distributed in the United States this decree is undoubtedly applicable.)

PARASITES AGAINST WHICH CERTIFICATION IS REQUIRED

(*Order of Apr. 20,1932 ; Gaceta de Madrid, No. 115, Apr. 24, 1932*)

In connection with the order of the Ministry of Agriculture, Industry, and Commerce, No. 624, of March 1, 1932, concerning a list of diseases and enemies of plant cultures, against which certificates issued by the French phytopathological service are to be adjusted with respect to shipments of living plants directed to Spain : This Ministry has resolved to transmit the list of insects, fungi, and bacteria whose presence in consignments of *plant products from any source,* which are shipped to Spain, or whose existence in the countries of origin will determine the prohibition of the importation of the plants, their fruits, seeds, or parts, which those parasites attack, and of articles that may serve as vehicles of infection.

Certificates of official phytopathological services of the various countries that export plant products and living plants to Spain must affirm the non-existence in the respective country of the diseases or pests caused by the agencies named in the said list.

List of insects, fungi, and bacteria whose presence in consignments of plants and plant products exported to Spain or whose existence in the countries of origin will determine the prohibition of the plants, their fruits, seeds, or parts which those parasites attack, and materials that may serve as vehicles of infection.

INSECT PESTS

(*Aleyrodes*) *Dialeurodes citri* Ashm., citrus whitefly, and other species of the same genus.

Anthonomus grandis Boh., boll weevil.

(*Aonidiella*) *Aspidiotus perniciosus* Comst., San Jose scale, on fresh fruits of any kind.

Coccus viridis Green, green scale, on coffee fruits and citrus plants.

Epitrix cucumeris Harr., potato flea beetle.

Icerya purchasi Mask., cottony-cushion scale.

(*Laspeyresia*) *Grapholitha molesta,* oriental fruit moth, in fresh fruits.

Leptinotarsa decemlineata Say., Colorado potato beetle on potatoes and other solanaceous plants.

Pectinophora gossypiella Saund., pink bollworm.

Popillia Japonica Newm., Japanese beetle.

(*Saskiaspis*) *Aulacaspis pentagona* Targ., white peach scale.

on apple (*Malus sylvestris* L.), apricot (*Prunus armeniaca*), cherry (*Prunus* spp.), cherrylaurel (*Laurocerasus* spp.), grape (*Vitis* spp.), Jessamine (*Jasminus* spp.), locust (*Robinia* spp.), mulberry (*Morus* spp.), peach (*Amygdalus persica* L.), pear (*Pyrus communis* L.), poplar Canadian (*Populus deltoides* Marsh), Sophora (*Sophora Japonica* L.), spindle tree or burning bush (*Euonymus*), white beam (*Sorbus*

aria Cranz.), willow (*Salix* spp.), cacao pods (*Theobroma cacao* L.), *Sesamia calamistis* Hmps., stalk borer of maize and millet. Exotic fruit flies.

FUNGI AND BACTERIA

Ascochyta chlorospora Speg., shot-hole and fruit spot of *Prunus*.

Bacillus amylovorus (Burr.) Trev., fire blight on plants and fruits of apple, pear, quince, and other cultivated or wild Pomaceae.

Bacterium citri Hasse, citrus canker, on citrus plants and fruits.

Ceratostomella (*Graphium*) *Ulmi* (Schwarz) Buisman, Dutch elm disease.

Corticium Koleroga (Cke) V. Hoeh, koleroga.

Corticium salmonicolor B. & Br., pink disease, on citrus plants, parts thereof, fruits, and peelings.

Diaporthe perniciosa Marchal, fruit tree canker.

Endothia parasitica (Murr.) And. & And., chestnut canker.

Fusarium cubense E. F. Sm., Panama disease, banana wilt, on plants and fruits of *Musa* and *Ananas*.

Guignardia bidwelli (Ellis) V. & R., black rot of grape, on rooted and unrooted cuttings of American and European grapes.

Gymnosporangium Juniperi-virginianae Schw., apple rust, on plants and fruits of apple and *Juniperus virginiana*.

Neofabraea malicorticis (Cordley) Jackson, black-spot canker of apple, on plants and fruits of apple, pear, and quince.

Phyllosticta solitaria E. & E. apple blotch, on plants and fruits of *Malus*.

Synchytrium endobioticum (Schilb.) Perc., potato wart, on potato tubers fruits and green parts of all Solanaceae, including tomatoes, eggplants, and peppers.

Thielaviopsis paradoxa (De Seyn.) v Hoech., black rot of sugarcane on plants and fruits of *Musa* and *Ananas*.

A COPY OF ORIGINAL CERTIFICATE REQUIRED FOR DRIED FRUITS IMPORTED AT HAMBURG

(Order of May 16, 1933 ; Gaceta de Madrid, No. 143, May 23, 1933)

Under reservation of the suspension of this order if the condition of shipments makes it advisable, shipments of dry or desiccated fruits proceeding from the port of Hamburg will be admitted into Spain only when accompanied by a copy of the phytosanitary certificate issued by authorized technical officials of the country of origin for each lot forming the shipment ; these certificates must be verified by the German technical officials of the port of Hamburg.

In addition, each such shipment must be accompanied by a phytopathological inspection certificate issued by the Hamburg technical officials. Finally, these shipments must be found in a satisfactory condition upon inspection by the Spanish National Phytopathological Service.

IMPORTATION OF COCONUT FIBER PROHIBITED

(Decree of Oct. 31, 1931 ; Gaceta de Madrid, No. 305, Nov. 1, 1931)

Prohibits the importation of coconut fiber into Spain, in order to assist the esparto grass industry.

CERTIFICATION OF MUSHROOM SPAWN REQUIRED

(Order of Nov. 18, 1931 ; Gaceta de Madrid, No. 325, Nov. 21, 1931)

Each shipment of mushroom spawn offered for importation into Spain must be accompanied by a phytosanitary certificate issued by an official of the phyto-pathological authority of the country of origin, affirming that the manure used for growing the spawn was sterilized before sowing (the method of disinfection being stated) ; further, that the sowing was made from a pure culture of mushrooms (*Agaricus campestris* L.) and that the product contains no pathogenic organisms injurious to crops.

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ARGENTINA REPUBLIC

PLANT QUARANTINE IMPORT RESTRICTIONS OF THE REPUBLIC OF ARGENTINA

Notification No. B. P. Q.-357, Supplement No. 4, July 20, 1936, issued by the United States Department of Agriculture, Bureau of Entomology and Plant Quarantine, Washington, D. C.

Authorized ports of entry

DECREE No. 69595, October 25, 1935, authorizes the importation of plants and plant products in general through the port of Mendoza, in addition to the ports of Buenos Aires and Bahia Blanca already designated.

Personal Notes, Appointments and Transfers, Meetings and Conferences, etc.

The Indian Central Cotton Committee

MR. T. R. LOW, B.Sc. Agri., Director, Institute of Plant Industry, Indore, has been nominated by the Durbars of the Indian States in Rajputana and Central India to be a member of the Indian Central Cotton Committee, *vice* MR. F. K. JACKSON, resigned.

The Imperial Veterinary Research Institute

MR. HARENDRA NATH RAY, M.Sc., P.R.S., Ph.D. (Lond.), University Lecturer in Zoology, at the University College of Science and Technology, Calcutta, has been appointed on probation for one year, to the post of Systematic Protozoologist at the Imperial Veterinary Research Institute, Muktesar, with effect from the 18th August 1936.

Madras

MR. R. W. LITTLEWOOD, I.A.S., Acting Principal, Agricultural College, Coimbatore, has been placed on special duty in the Live-stock Section for a period of two months from the 1st November 1936.

MR. D. G. MUNRO, B.Sc. (Aber.), Deputy Director of Agriculture, VIII Circle, has been appointed to act as Principal, Agricultural College, Coimbatore, *vice* MR. R. W. LITTLEWOOD, Officiating Principal, placed on special duty with effect from the 1st November 1936 or date of taking charge.

MR. K. T. ALWA, L.Ag., Deputy Director of Agriculture, Tellicherry, in category 4, class I, Madras Agricultural Service, has been appointed to act as Headquarters Deputy Director of Agriculture, Madras, in category 2, class I, Madras Agricultural Service, *vice* RAO SAHIB C. NARAYANA AYYAR, Dip. Agri., due to retire on the 18th November 1936.

MR. M. KANTI RAJ NAYUDU, M.A., B.Sc. (Edin.), Assistant Director of Agriculture in category 6 of class I of the Madras Agricultural Service, has been appointed to a post in category 8 of class I of the same service and posted to act as Superintendent, Agricultural Research Station, Anakapalle, with effect from 1st November 1936 or date of taking charge.

MR. PERCIVAL VENKATARAMAYYA, M.A., B.Sc. (Edin.), Assistant Agricultural Chemist, in category 7 of class I, Madras Agricultural Service, has been appointed Agricultural Chemist, Coimbatore, in category 5 of class I, Madras Agricultural Service, with effect from the 23rd August 1935.

MR. K. M. THOMAS, B.A., M.Sc., Assistant in Mycology in category I of class I of the Madras Agricultural Subordinate Service and a probationer in category 7 of class I of Madras Agricultural Service, has been appointed to a post in category 5 of class I, Madras Agricultural Service, and to officiate as Government Mycologist, Coimbatore, from the 7th November 1936 or date of taking charge, *vice* RAO BAHADUR S. SUNDARARAMAN retiring from service on the 7th November 1936.

MR. T. S. ALAGAPPA PILLAI, G.M.V.C., on return from leave, has been appointed District Veterinary Officer, Nellore.

MR. T. VINAYAKA MUDALIYAR, G.M.V.C., Acting District Veterinary Officer, Nellore, on relief by MR. T. S. ALAGAPPA PILLAI, has been appointed to act as District Veterinary Officer, Madras.

MR. H. N. CHELVA AYYANGAR, G.M.V.C., Veterinary Assistant Surgeon in the Selection grade and Officiating Lecturer in Anatomy in the Madras Veterinary College, has been appointed to the Madras Veterinary Service in category 3 of class I, as Lecturer in Anatomy with effect from the 17th July 1933.

MR. K. SESHAGIRI RAO NAYUDU, G.M.V.C., Veterinary Assistant Surgeon in the Selection Grade and Officiating District Veterinary Officer, has been appointed to the Madras Veterinary Service in category 4 of class I, provisionally

substantive, with effect from the 28th July 1933 in the vacancy caused by the suspension of the lien of Mr. K. Kailasam Ayyar, G.M.V.C. upon his appointment as District Veterinary Officer and substantively with effect from 9th April 1934 in the vacancy caused by the demise of Rao Sahib H. C. Sampath Ayyangar.

Mr. M. A. Rangaswami Ayyar, B.A., G.M.V.C., Veterinary Assistant Surgeon in the Selection Grade and Officiating Lecturer in Physiology, Madras Veterinary College, has been appointed to the Madras Veterinary Service in category 3 of class I, as Lecturer in Physiology, with effect from the 2nd July 1934.

Mr. A. Castelino, G.M.V.C., Veterinary Assistant Surgeon in the Selection Grade and Officiating District Veterinary Officer, has been appointed to the Madras Veterinary Service in category 4 of class I, with effect from the 14th July 1934, in the vacancy caused by the demise of Mr. A. J. Wilson.

Bombay

The following appointments have been made with effect from the 2nd November 1936—

Mr. W. J. Jenkins, M.A., B.Sc. (Edin.), I.A.S., to officiate as Director of Agriculture.

Mr. B. S. Patel, N.D.D., N.D.A., C.D.A.D., on relief by Mr. Jenkins, to be Deputy Director of Agriculture, Gujarat.

Mr. B. S. Patel, N.D.D., N.D.A., C.D.A.D., Acting Director of Agriculture, has been granted leave on average pay for four months from the 2nd November 1936 or the subsequent date on which he may be relieved.

Mr. G. B. Patel, on return from leave has been appointed to be Cotton Breeder, North Gujarat, Viramgam, with effect from the 1st October 1936.

RAO SAHEB G. L. KOTTUR, Cotton Breeder, Southern Mahratta Country, Dharwar, has been granted an extension of leave by two months on average pay with effect from 1st September 1936 in continuation of the leave for one month granted to him by the Director of Agriculture.

DR. JAMSHED ARDESHIR DAJI, Assistant Investigator, Dry-farming Research Scheme, has been appointed to be Agricultural Chemist to Government, *vice* RAO BAHADUR D. L. SAHASRABUDHE, M.Ag., M.Sc., retired.

MR. E. J. BRUEN, Live-stock Expert, has been granted leave on average pay for eight months with effect from the 31st March 1937 or the subsequent date on which he may be relieved.

MR. M. G. KULKARNI, Veterinary Inspector, Central Range, has been appointed to act as Deputy Superintendent, Bombay City and Harbour Veterinary Department, *vice* MR. D. G. HAJI, retired.

Bengal

MR. GOSTA BEHARI PAL, M.Sc., Assistant Agricultural Chemist in the Bengal Lower Agricultural Service, has been appointed to the Bengal Higher Agricultural Service as Agricultural Chemist, Bengal, on probation.

MR. BALWANT SINGH, G.P.V.C., Officiating Head Laboratory Assistant, Izatnagar, has been appointed to act as Veterinary Investigation Officer, Bengal, with effect from the 15th July 1936, *vice* MR. M. B. MENON.

United Provinces

DR. S. B. SINGH, M.Sc., Ph.D. (Lond.), has been confirmed as Deputy Director of Agriculture, with effect from the 12th July 1936.

MR. J. A. MANAWWAR, M.A., B.Sc. (Edin.), M.S.A. (Texas), Assistant Director of Agriculture, has been posted to be provisionally substantive Professor of Agriculture at the Agricultural College, Cawnpore, in the temporary post in the

United Provinces Agricultural Service, class I, *vice* MR. T. R. LOW, I.A.S., transferred on foreign service to Indore, but to continue to work as Provincial Marketing Officer, United Provinces.

Punjab

DR. KHAN A. RAHMAN, B.Sc. (Edin.), on return from leave resumed charge of the office of Assistant Professor of Entomology, Punjab Agricultural College, Lyallpur, on the 27th July 1936, relieving MR. K. G. BHANDARI who reverted to his officiating appointment in the subordinate service from the same date.

KHAN SAHIB M. MOHAMMAD ABDULLAH, P.V.S., Deputy Superintendent, Civil Veterinary Department, Ferozepore, has been appointed Officer-in-Charge of the duties of the post of Superintendent, Civil Veterinary Department, Ambala Division, Ambala, with effect from the 13th August 1936, until further orders, *vice* MR. J. S. GAREWAL, M.R.C.V.S., I.V.S., deputed to the Central Provinces, as Officiating Director, Veterinary Services, on probation for one year.

MR. B. N. HANDA, B.Sc., M.R.C.V.S., Superintendent, Civil Veterinary Department, Lahore and Jullundur Divisions, Ferozepore, will carry on the work of the Deputy Superintendent, Civil Veterinary Department, Ferozepore, in addition to his own duties.

SAIYED MUBARIK ALI SHAH, B.Sc. (Hons.), M.R.C.V.S., has been appointed substantive permanent to the Punjab Veterinary Service, class I, with effect from the 1st July 1936 in the vacancy caused by the confirmation of MR. T. J. EGAN, I.V.S., as Director, Civil Veterinary Department, United Provinces.

The services of MR. J. F. SHIRLAW, M.R.C.V.S., Professor of Pathology, Punjab Veterinary College, Lahore, are placed at the disposal of the Government of India with effect from the afternoon of the 30th June 1936 for appointment as Veterinary Research Officer, in charge of the Pathological Section, Imperial Veterinary Research Institute, Muktesar, on probation for two years.

CAPTAIN U. W. F. WALKER, M.C., M.R.C.V.S., I.V.S., Professor of Surgery, Punjab Veterinary College, Lahore, on return from leave, has been posted as Professor of Surgery, Punjab Veterinary College, Lahore, with effect from the 1st October 1936, relieving MR. MUSHTAQ AHMAD, P.V.S., Hospital Surgeon, Punjab Veterinary College, Lahore, of the additional charge.

MR. PRAN NATH NANDA, M.R.C.V.S., has been appointed substantive permanent to the Punjab Veterinary Service, class I, with effect from the 9th January 1936, in the vacancy caused by the retirement of K. S. KHAWAJA GHULAM HASSAN.

MR. RAM RATTAN GHULATI, M.R.C.V.S., has been appointed provisional permanent to class I, of the Punjab Veterinary Services, with effect from the 9th January 1936, *vice* MR. PRAN NATH NANDA, confirmed.

Central Provinces

MR. P. D. NAIR, Agricultural Assistant in the Subordinate Agricultural Service, has been appointed as Assistant Director of Agriculture (on probation) in the Central Provinces Agricultural Service, Class I (new scale), with effect from the 1st October 1936, and has been attached to the office of the Director of Agriculture, Central Provinces.

REVIEWS

The Application of Electricity to Fruit Farming. By S. S. NEHRU, B.A., B.SC. (ALLD.), M.A. (CANTAB.), PH.D. (HEIDELBERG), I.C.S. Published by the Superintendent, Printing and Stationery, United Provinces, Allahabad, 1935, price annas 8.

THE author has been conducting experiments in electroculture of plants since 1929 and has already recorded the results of his experiments in three publications, Bulletins Nos. 53, 61 and 62 issued by the Superintendent of Printing and Stationery, United Provinces, in the years 1931, 1932 and 1933, respectively. The present bulletin deals with the application of electricity to fruit-farming. Its main object is to show that if garden plants and trees or even parts of trees are provided with a jacket of iron wire-netting, or if a wire net is placed in a seed-bed, or if a single pot plant is provided with a wire antenna, growth is very considerably improved due (according to the author) to the capturing of electro-magnetic energy from the earth and the air. Onions are also stated to be rich in electro-magnetic energy and planting onions round a backward tree is said, for this reason, to improve its growth. There is also a short passage dealing with the application of artificial electrical energy to plants. There are 11 pages of letter-press and 9 pages of illustrations showing photographs of treated and untreated plants and fruits. Those who are specialists in the subject of electro-magnetic energy will find it interesting to attempt an explanation of the phenomena, while those accustomed to modern methods of measuring the significance of agricultural experiments will be hard put to it to extract anything convincing from the results as recorded. This is a pity, since, if the simple jacketing of a fruit tree with wire-netting gives the results claimed, we have got here a method that deserves serious attention. [W. B.]

The Use and Misuse of Land : Oxford Forestry Memoirs No. 19, 1935. BY R. MCLAGAN GORRIE, D.Sc., F.R.S.E. (Oxford : At the Clarendon Press, 1935). 6*s*. net.

SOIL-EROSION is a subject of considerable importance in very large tracts both of the hills and plains of India. Attention was drawn to the damage resulting from soil-erosion by Mr. Baden-Powell, Conservator of Forests, Punjab, as far back

as 1877. Government enquiries into the nature and extent of the damage caused by soil-erosion have been held. The *Chos* Act of 1900 controlled the right of grazing but the application of this Act was very limited. At the present time it can be said that except for small areas, control of soil-erosion is non-existent. The author has done a great service in drawing attention to the importance attached to this subject in another country.

The Memoir gives an excellent account of the researches that have been carried out in the United States. Its preparation must have involved a considerable amount of rough touring carried out in a short time and a thorough search of the literature available on the subject. The author is to be congratulated on having produced a book which will be a standard work for reference on this subject in the future.

The work has been admirably planned to bring out the relation between forestry in the hills and agriculture in the plains. In the past, the tendency has been to regard these two subjects as independent except possibly in the sub-montane tracts where the effect of soil-erosion is brought home to the zemindars by the large areas of land which have gone out of cultivation through *Cho* formation.

The importance of forest cover in the hills on both the surface and underground water supplies of the plains is not fully realised because data which would indicate the relationship are scanty. The fall in the sub-soil water-table in the Jullundur area is attributed to the over-grazing of the Siwaliks Hills. High peak flood discharges in many rivers may be attributed to the same cause. The effect of forests on the winter supplies of water in the areas of Northern India may be of considerable importance. Recently, attention has been drawn by Dr. Church in America to the effect of forest cover on snow accumulation—an important problem connected with river supplies in April and May in Northern India. A knowledge of the factors concerned would be of considerable value in forecasting river conditions in the spring.

As the result of Dr. Gorrie's researches the way is now clear for an attack on erosion problems in India. Methods of investigation are available, methods of control of erosion have been devised, it now remains for these methods to be applied. It is to be hoped that in his further work on this subject the author will receive the support, both financial and administrative, that the subject warrants. [E. McK. T.]

(The reviewer has explained that the term *Cho* means a hill torrent which carries a large amount of sand down to the plains and causes the destruction of cultivated land. Ed.)

NEW BOOKS

On Agriculture and Allied Subjects

Agricultural Marketing in Agra District (St. John's College, Agra Research Department Memoir No. 2). By H. L. Puxley, M.A. (Oxon.), M.A. (Yale). Pp. 85 (Calcutta, Bombay, Madras, London, New York, Toronto: Longmans, Green and Co., Ltd.). Price Rs. 2.

The Application of Electricity to Fruit Farming. By S. S. Nehru, B.A., B.Sc., M.A., Ph.D., I.C.S. (Printing and Stationery, United Provinces, Allahabad, India, 1935). Price As. 8.

The Apples of England. By H. V. Taylor, O.B.E., B.Sc., A.R.C.Sc. Foreword by Sir A. D. Hall, K.C.B., LL.D., F.R.S. Pp. 266 and 11 figs. (London: Crosby Lockwood and Son, Ltd., 1936). Price 21*s*.

All about the Soya Bean. By George Douglas Gray, M.D., C.B.E. (London: John Bale, Sons and Danielsson, Ltd.). Price 7*s*. 6*d*. net.

Morphology of Vascular Plants. Lower Groups (Psilophytales to Filicales). By Arthur J. Eames. Pp. 433, 9 × 6, 215 illustrations. (London: McGraw-Hill Publishing Co., Ltd.). Price 24*s*. net.

The Origin of a Land Flora: A Theory based upon the Facts of Alternation. By Prof. F. O. Bower, Sc.D., LL.D, F.R.S. 8vo. (London: MacMillan and Co., Ltd.). Price 21*s*. net.

Citrus Diseases and their Control. By Howard S. Fawcett Pp. 656, 9 × 6, 187 illustrations. (London: McGraw-Hill Publishing Co., Ltd.). Price 36*s*. net.

The Genetics of Garden Plants. By M. B. Crane and W. J. C. Lawrence. With 53 illustrations and 42 tables. Medium 8vo. (London: MacMillan and Co., Ltd.). Price 10*s*. 6*d*. net.

Heredity in Poultry. By Prof. R. C. Punnett, F R.S. Crown 8vo. (London: MacMillan and Co., Ltd.). Price 3*s*. 6*d*.

Heredity in Live-stock. By Christian Wriedt. With a Foreword by Prof. R. C. Punnett, F.R.S. Crown 8vo. (London: MacMillan and Co., Ltd.). Price 7*s*. 6*d*. net.

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II. Obtainable from the Imperial Bureau of Animal Health, Veterinary Research Laboratory, New Haw, Weybridge, Surrey

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17. Vernalization and Phasic Development of Plants. December, 1935. (Joint publication of the Imperial Bureaux of Plant Genetics) . . 10 0

VI. OBTAINABLE FROM THE IMPERIAL BUREAU OF FRUIT PRODUCTION, EAST MALLING RESEARCH STATION, EAST MALLING, KENT

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Occasional Papers

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Other Publications—

Index to Volumes I-X of the *Journal of Pomology and Horticultural Science*, 1933. Compiled by Bureau, published by the Editors of the *Journal of Pomology and Horticultural Science*. Available from the Bureau 5 0
Old and New standpoints on senile degeneration, 1931. By A. P. C. Bijhouwer 0 6

VII. OBTAINABLE FROM THE IMPERIAL BUREAU OF ANIMAL GENETICS, INSTITUTE OF ANIMAL GENETICS, UNIVERSITY OF EDINBURGH, KING'S BUILDINGS, WEST MAINS ROAD, EDINBURGH

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ORIGINAL ARTICLES

THE RELATION OF ANIMAL NUTRITION TO PUBLIC HEALTH IN INDIA*

BY

A. OLVER, C.B., C.M.G., F.R.C.V.S., F.N.I.,

Animal Husbandry Expert, Imperial Council of Agricultural Research

BEFORE proceeding with my address, I must express my very sincere thanks for the honour of having been invited to preside over the Medical and Veterinary Section this year; an honour which, I can assure you, I accepted with considerable trepidation. For apart from any difficulty a veterinarian must experience in dealing adequately with purely medical questions, I have for a long time past been engaged almost exclusively with administrative matters and I have found it difficult to select a suitable subject for my presidential address. In the end I have decided to discuss what, besides being of wide scientific interest, is at the moment a highly topical subject, and one of very great practical importance to the people of India, *viz.*, the many and varied problems which are involved in providing a more adequate diet—for farm live-stock as well as for the people—at a cost which is not prohibitive for the comparatively poor.

Probably the greatest and most difficult of all the problems which Governments have to face in India to-day is the problem of providing, at a cost within the reach of the masses, an adequate and satisfactory supply of the protective foods of animal origin, especially milk. In spite of every effort to find effective vegetable substitutes these foods have, in recent years, been shown to be irreplaceable in human diet and owing to the rapid increase in population which is taking place, this problem is becoming daily more difficult. It is clear in fact that the best possible use will have to be made of all the food resources which are or could economically be produced from the available land and it is here that animal nutrition has a great role to play in the maintenance of public health. Only by systematic and properly controlled investigation of the feeding values of locally grown foodstuffs, in relation to the requirements of the live-stock of the country, is it possible to make the best use of the great variety of cattle foods which can satisfactorily be grown under the varying conditions of soil and climate which exist in this sub-continent. Apart from its importance to the health and development

*Presidential address to the Medical and Veterinary Research Section of the Indian Science Congress, Hyderabad-Deccan, January, 1937.

of the people, systematic investigation, throughout India, of the food values of cattle foods is moreover a matter of huge economic significance and I propose to discuss very briefly a few points of mutual interest to human and animal dieteticians and to suggest ways in which proper attention to the nutritional requirements of farm live-stock might make available, at reduced cost, larger and better supplies of these protective foods.

Before considering the problem of economic production it is however necessary to have some authoritative basis on which to found our conceptions of what is needed for the proper nutrition of the human race and, until further research has been carried out, in India, we cannot do better than adopt the standards which have recently been published by the Health Organisation of the League of Nations, in the report of their meeting held in London in November 1935.

From this report and the attached tables it may be seen that great emphasis is laid throughout on the essential importance, to proper development and maintenance of health, of foodstuffs of animal origin and particularly of milk and eggs. It may be that strict vegetarians will still contend that the necessity for animal foods in human diet is not fully proven but it is clearly impossible for any official body, concerned with the proper nutrition of a people, to ignore such an authoritative and definite pronouncement as this by a body of scientists who during the past ten years have been engaged, under the auspices of the League of Nations, in determining, firstly, what an optimum diet for the human race should consist of and secondly how far it is feasible, in existing circumstances, to provide an ideal or better diet for the generality of the people.

Moreover their views have of recent years received more than ample confirmation from very extensive controlled observations, which have been and are being carried out in many countries, as to the effect of an addition of some milk to the ordinary diet of school children, and others, whose diet would otherwise consist mainly of the cheaper vegetable foods.

The Commission also stressed the importance of proper diet in relation to the prevention of disease, an aspect of nutrition to which McCarrison working at Coonoor was among the first to draw particular attention.

Indeed McCarrison appears to have been the first to demonstrate the great possibilities of controlling infection by the provision of an ideal diet, associated with strict attention to Hygiene.

Previously, during the later years of the past century, Voit had already shown that a proper proportion of minerals in the diet is essential to proper utilization of foodstuffs, and Theiler and his co-workers in South Africa had demonstrated the causative role of mineral deficiencies in relation to a group of live-stock diseases, *e.g.*, Lamziekte and Osteo-dystrophia, which previously had not been properly understood. By co-ordinated veterinary and bio-chemical research he showed that nutritive defects, consisting mainly of inadequacy of minerals and vitamins,

were the primary causes of the reduced resistance and increased exposure to infection from which, in their attempt to rectify these deficiencies, South African live-stock, over wide areas of arid country, contracted the infection which ultimately caused sickness or death.

The great importance of Theiler's work however lay in the fact that he was the first to demonstrate clearly the causative role of faulty nutrition in regard to a large group of diseases from which farm live-stock are liable to suffer and which at one time made the rearing of live-stock difficult and even impossible over large areas and in many countries.

Since these pioneer observations were made the essential importance of mineral matter for the proper growth, development and reproduction of experimental animals has repeatedly been demonstrated and Orr and others, quick to realize the importance of Theiler's work, have extended widely his observations as to the pathogenic role of mineral and vitamin deficiencies in various parts of the world.

One need only mention the group of diseases on which Theiler's initial observations were made in South Africa, and the so-called Bush-sickness of New Zealand and other countries, due to iron deficiency, to illustrate the great economic importance of an adequate supply of minerals in animal diet, and though the field has scarcely been scratched recent systematic investigation of stock diseases in this country, carried out by specially employed veterinary investigation staff and others, has produced ample evidence of severe marasmus and mortality among live-stock in India, traceable to deficiencies of essential mineral matter in the foodstuffs available.

Modern research on the vitamins has also led to a far more exact appreciation of the principles on which the feeding of live-stock must be based and the importance of the accessory food factors in animal nutrition is now no longer disputed. Owing largely to their elusive nature and the comparatively minute quantities required they were long regarded as something in the nature of a medical fad but there is now ample evidence that these substances play a most important role in the nutrition of farm live-stock. For example in India it has recently been shown that a nutritional deficiency is the main causative factor in the production of a specific form of blindness with which, until measures were taken to provide an adequate supply of fresh green stuff approximately 40 per cent of all the calves produced in a certain herd were affected ; most of them being totally blind at birth and many unable to carry on an independent existence. Investigation of the conditions under which this herd was maintained, combined with controlled experimentation at the Muktesar Institute, has in fact shown that the condition of these calves was due to a lack of vitamin A in the diet of the herd ; which at that time had little land at its disposal for the production of green fodder. It was shown in the course of these investigations that

the condition could be produced by feeding pregnant cows on an autoclaved diet which, in other respects, was similar in composition to that on which large numbers of cattle are regularly maintained at the Institute in perfect health.

It was moreover shown that it is not possible to maintain cattle for any length of time on autoclaved food. For very shortly after being placed on such a diet the cows under experiment lost condition so rapidly and became so obviously ill that it was necessary to add a proportion of un-autoclaved food to the ration, to obviate vitiation of whole experiment owing to demise of the experimental animals.

The essential importance of an adequate supply of vitamin A to cattle was thus clearly demonstrated and it is of interest that similar cases of natal blindness in calves have since been detected in other parts of India; particularly in big cities, where the diet consists mainly of dry fodder and concentrates.

It is further of considerable interest that in the course of these investigations instances occurred of calves, born from mothers which had previously received an ample supply of green fodder, which developed this form of blindness within a short period of arrival at the station concerned; where as mentioned above the supply of green stuff was very deficient. These observations seem to indicate quite clearly that milk from cows fed almost exclusively on dry food materials, on which cows are usually fed in city dairies in India, and during the dry season in many parts of India, is very lacking in vitamin A. It is rational therefore to assume that the milk of cows maintained in city dairies where adequate supplies of green fodder are costly and difficult to obtain cannot usually be considered a satisfactory food, particularly for children. This is a point which I am sure deserves much greater attention than it has hitherto received from the general public.

Aykroyd and others have on the other hand recently demonstrated that striking improvement in the health and development of school children in India can rapidly be effected by the addition of small quantities of cow's milk to their diet and it is a matter of very considerable importance to human dieteticians in India that in the course of these observations it has been shown that skimmed or separated milk—or reconstituted milk made with skimmed milk-powder—are very valuable foods, when taken along with adequate amounts of great leaf vegetables or fruit and adequate exposure to sunlight. It seems in fact that while the supply of vitamin A and of carbohydrates may be adequate in the ordinary diets of India, the content of protein of high biological value and of the essential minerals and other accessory food factors, which are contained in skimmed and separated milk, and in milk-powder, must be definitely lacking in those diets. Great improvement in health and physique could therefore be effected, at comparatively small cost, if the consumption could be increased of skimmed or separated milk or of milk-powder—in which all the proteins and mineral salts of whole milk remain almost intact.

In considering the proper nutrition of a people it is necessary to go right down to fundamentals such as the composition of the soil on which the foodstuffs consumed by live-stock are produced and to such matters as the effect of different systems of cultivation and grazing on the quality of the cattle foods produced, and this brings me to another aspect of nutrition to which I wish to refer, *viz.*, the quality of the proteins available in foodstuffs of animal origin. In the past, in estimating the feeding values of foodstuffs, attention was paid mostly to the quantity of carbohydrate, protein and salts, present in the various constituents of the diet, but in more recent years the essential importance of animal proteins of high biological value has become more and more recognized. The amino acids which enter into the composition of a diet are in fact of great importance to dieteticians and this is a factor in relation to which the nutrition of farm live-stock and indeed of the crops on which they are fed must play an important part in human nutrition.

For example, it is well known by expert stock-breeders and feeders that the quality of their stock and the price they fetch in the market depends very largely on the quality of the foodstuffs upon which they have been reared and maintained, and for that reason good graziers and stock-breeders have always paid particular attention to the proper manuring and management of their grassland and to quality in the foodstuffs fed to their stock.

But until comparatively recently it was generally assumed that the difference between the results obtained from good and poor pastures lay mainly in the higher protein and starch content of the former.

Orr and his co-workers have however shown that the most important difference between grass grown in well-managed land or under artificial cultivation and that produced on poor pastures lies in the comparatively high mineral content of the former. They have further shown that if the mineral content falls below a certain point the material becomes unpalatable to stock and is refused, while the absorption of such minerals as are present in overripe and innutritious fodders is defective.

To a country such as India where every year there is a period when natural growth of succulent fodder is almost at a stand-still and where the foodstuffs available for stock are mostly dry, overripe, crop residues which have long been exposed to sun and rain, these observations are of the utmost practical importance, to human as well as animal dieteticians, since the provision for stock of a diet of good quality presents difficulties which are not at all met with in countries where rainfall is more evenly distributed and sun light is not so intense.

It is thus essential for the proper feeding of the people that facilities should be provided for systematic research on the composition and proper conservation and utilization, by indigenous types of live-stock, of such fodder and other food material as can be made available at reasonable cost.

In this connection it is necessary also to remember that we have evidence to show that the capacity of Indian cattle, of pure Indian origin, to utilize comparatively dry and innutritious foodstuffs, is high compared with that of cattle of European origin and higher in some breeds than in others, while it seems that the hump or fat tail which is so commonly met with in desert animals and in Indian live-stock may be of greater significance in nutrition than has commonly been supposed.

But though it is a truism that well-fed meat and milk of good quality are of higher biological value than similar material of lower quality it seems to be little understood in India that an adequate supply of such high quality foods can only be produced by the provision of a better supply of nutritious and easily digestible foodstuffs. Fodder crops of good quality can in fact only be grown under a system of cultivation or management of grassland which is calculated to furnish an ample supply of plant food.

Proper mixed farming, combined with proper management of grasslands and suitable conservation of cattle foods of good quality, is thus a matter of importance to human dieteticians as well as to the farming community. The coarse grass which is grown in the wetter parts of India is indeed so deficient in nutritive value and becomes so indigestible that it is not possible to produce high grade stock or animal products of good quality unless provision is made for an adequate supply of specially grown fodder crops or concentrates. Cattle reared exclusively on such grass are in fact commonly so poor that they are of little use as work or milch animals and rightly fetch such low prices for slaughter that their production is an unremunerative drain on the fodder resources of the country.

We are faced here with the apparent paradox that, in India, the best developed cattle are produced in areas where the natural growth of grass is comparatively scarce. But the position is not so paradoxical as it may seem, since in dry areas stock-owners are forced to provide supplementary foodstuffs of comparatively high biological values for their stock. Further in order to keep them alive during periods of drought and to meet the cost of providing supplementary foodstuffs they are forced to maintain only such numbers of comparatively good cattle as can produce sufficient return, from milk, or form the production of valuable work animals, as will justify the outlay on fodder production. Moreover such grass as is produced is usually of comparatively high feeding value.

How to make the production of suitable fodder crops economically possible, in a system of agriculture which must perforce be governed largely by the very limited capital resources of the Indian cultivators, is however one of the most difficult of the problems with which the better nourishment of the people of India is beset.

In existing circumstances it is obviously difficult for poor cultivators to modify the present unsound system of agriculture, in which attention is so often almost exclusively paid to the production of cereal grains or other cash crops, but it seems clear that any improvement in the feeding of the people must depend very largely on the success which is achieved in modifying this system.

Particularly in hot climates subject to seasonal droughts and a tropical sun, nothing can take the place of humus in maintaining the fertility of the soil and it seems that, in order to maintain fertility, the rearing and maintenance of better cattle, under semi-stall-feeding conditions, by the introduction of more fodder crops into the rotation, must be an important factor in the solution of the cognate problems of human and animal nutrition in India. Though it is obviously difficult for a poor cultivator to find money for fodder crops, from which he is usually unable to obtain a direct cash return, it would in my view be wrong to adopt a defeatist attitude in this matter. It has in fact been demonstrated in various parts of India, that where a steady market for animal products has been provided, *e.g.*, for milk or ghee, the cultivator has found ways and means of obtaining, and maintaining satisfactorily, the stock of better class which are needed to enable him to get a satisfactory return from his outlay.

The provision of up-to-date facilities for the rapid transportation, under satisfactory conditions, of perishable animal products, from the mofussil to big cities, and for better control and proper development of the marketing of such products, are thus matters in regard to which money invested by Governments should receive an ample return in the improved health and prosperity of the people.

Indeed the scientists of India could turn their attention to no greater or more stimulating task than that of providing an increased supply of cattle foods of good quality all the year round and of finding ways and means of developing in Indian villages a system of balanced agriculture by which the people could be better fed and the wealth of the country increased. In this task it is clear that systematic Animal Husbandry will have to play a very important part, since at present, owing to lack of precise knowledge of the food values of the foodstuffs usually produced in India, and of their utilization by Indian live-stock, huge quantities of valuable food material are undoubtedly to a large extent wasted.

Mr. Bruce, the Premier of Australia, stated sometime ago that the time had come when Agriculture should be married to Public Health and I would particularize that, in India, Agricultural Science and organized Animal Husbandry should be intensively applied, in collaboration, to this problem of the economical production of the protective foodstuffs of animal origin, an increased supply of which is particularly necessary for the proper health and development of the people of this country.

I suggest that the solution must to a very large extent lie in educating the public as to the essential importance to health of an adequate and sound supply of milk and other foodstuffs of animal origin and in providing better facilities for their production, preservation, transportation and marketing, so that village cultivators and stock-owners may be able to produce more fodder crops, more and better farmyard manure or compost, and better stock; thereby increasing their income and the nutrition of the family while maintaining the fertility of their holdings and making a substantial contribution to the maintenance of public health.

THE GRAZING PROBLEM IN INDIA

BY

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SINCE the issue of the Report of the Royal Commission on Agriculture in 1928, considerable advance has been made in many of the subjects dealt with in the Report, but one subject of which this cannot be said is that of grazing. The subject is dealt with very exhaustively in Chapters VII and VIII of the Report and no attempt is made to minimise the difficulties of the problem ; in fact both the difficulties and the importance of the subject are stressed in the following sentence :—

> " We are well aware of the difficulties likely to be met with in practice in getting owners of cattle to adopt more rational methods of utilising the diminishing grazing areas of India, but the poverty of so large a proportion of the breeding herds of the country is such a serious handicap to the improvement of agriculture, and the management of the available grazing lands is so bad, that a great effort to alter existing conditions is necessary, and is indeed long overdue."

These words were written eight years ago, and there appear to be two very cogent reasons why the problem should be tackled in earnest without any further delay. The first is that what was described by the Royal Commission as " pressure on the land " from an increasing human population is a matter of still greater concern since the issue of the latest census figures, which show a 10 per cent increase in the last decade. The demand for cultivable land is, therefore, certain to increase.

The second reason, which is particularly the concern of animal husbandmen, is that the provision of better grazing facilities is a necessary adjunct to any campaign for the improvement of India's cattle population, particularly that most essential item, the working bullock.

In order to make the position clear, it should be explained that cattle are kept in this country mainly for three purposes :—

(*a*) For the provision of milk to large towns, hill stations, etc. For this purpose the best cows available are imported, stall-fed, and the young stock are generally neglected.

(b) For the production of a general utility animal, usually with the help of special fodder crops. The number and size of such areas is small at present, but they may be expected to increase as marketing facilities are developed, for the incentive to the production of this class of animal is sale, either of the animal itself or its products.

(c) For the production of working bullocks. The vast majority of villages in India fall into this group, and it is the group to which the recommendations of the Royal Commission particularly apply, not least because for the production of the best type of working bullock grazing land is essential.

Moreover this group is important for the reason that, owing to inferior methods of cultivation, the great majority of the ryots living in these villages are not able to produce sufficient food even for their families, so that their animals willy-nilly have to depend for their living on what grazing is available, with merely the residue of the crops grown for human consumption thrown in. Also it may be observed that as methods of cultivation improve the most probable result will be a further increase in human population, unless the advocates of birth control are able to make headway. In any case there is little likelihood of any wide-spread movement in favour of growing special fodder crops taking place in these areas in which the primary consideration is the production of working bullocks.

We are, therefore, forced to the conclusion that this question of grazing is, and is likely to remain for any ordinary period of time, a most vital one to the vast majority of villages in India. These villages, *i.e.*, those in group (*c*), can again be divided into two main classes, *viz.*, (*i*) those which at present have no suitable grazing for their young stock within a reasonable distance, and (*ii*) those which are either adjacent to grazing grounds or from which the animals can be taken to grazing areas at certain seasons of the year.

As regards the first class if, even after re-classification, no suitable grazing land is available, it seems that the only advice that can be given is to practice restricted breeding, and disposal of the unfit. The cows give insufficient milk even for their seldom-produced calf, and it would make matters worse to attempt to introduce higher yielding animals, which would require more food. The bullocks are of very little value as such, and in some parts are mainly kept for the production of manure or fuel. In these villages it will be found that there are usually a few better class bullocks purchased from outside and it would obviously help these unfortunate ryots if their facilities for obtaining suitable bullocks at a reasonable cost from the areas falling under (*ii*) could be improved.

This, therefore, brings us to class (*ii*), *i.e.*, those villages which are adjacent to actual or potential grazing areas, and in this connection it may be pointed out that some of the most valuable grazing areas in the country are to be found in Indian States, who are therefore very much concerned with this problem,

As regards British India the Royal Commission points out that of the total area of land about 20 per cent of it is administered by the Forest Department and 45 per cent is classified as " cultivable waste ", or " land not available for cultivation", and it makes the recommendation that in the case of both these areas the classification should be re-examined with a view to providing better grazing facilities for India's live-stock. With reference to the area now administered by the Forest Department the Commission states : " The ideal to be aimed at in all provinces is to distinguish between land which is suitable for the growth of good timber trees or for fuel plantations and land which is suitable neither for timber, fuel plantations nor for ordinary cultivation, but may possess possibilities for development as fodder reserves and grazing grounds ". Action on these lines has, of course, already been taken in some provinces, notably in Madras, where the formation of Panchayat village forests has been encouraged on a large scale, but it appears that the Commission did not contemplate any large extension of this arrangement but rather that such grazing lands, after re-classification, should be administered by a special branch of the Forest Department as a demonstration of what can be done under scientific control. In regard to these forest grazing areas the Commission states : " Because of their small commercial value and also because the important forests give scope for all the energies of the existing forest staff, little attention has been given to the development of the second type of forest property. Nor do we think it likely that it will ever receive the attention that should be given to it unless it is placed under the management of a division of the Forest Department directly responsible for its development."

Turning now to the areas classed as " cultivable waste " and " land not available for cultivation " the Commission remarked : " We think it likely that within these vast areas there could be found much land which, although unsuited for commercial afforestation, might, if placed under the charge of a minor forest division, be used to grow fuel and provide better grazing than it now does."

The Commission realized well enough that to effect any improvement time and money would have to be spent and a good deal of close study given to the problem by officers specially selected and trained for the purpose, but they conclude their remarks with the statement : " We are satisfied that a share of the attention which has hitherto been bestowed on the valuable section of the country's forest property should now be spared for, and concentrated on, the problems presented by that section of the forest land now regarded and treated as waste."

Quotations have been made from the Commission's report *in extenso*, for the recommendations made are far reaching and appear to offer one of the very few practicable means of finding a solution for the greatest problem confronting animal husbandmen in India today, *viz.*, the provision of more and better food for her cattle, and this again, it may be observed, is only part of the bigger question of the nutrition of both her human and animal populations.

A plea is, therefore, put forward that a deeper study of this intricate problem should be made in all provinces, and as an example of what may be done, even with most unpromising material, the grassland improvement recently effected in North Wales may be quoted.

The items of work which seem to call for early attention in this country, if better use is to be made of grazing lands, are the following :—

(*i*) Soil and plant surveys.

(*ii*) Analysis and feeding trials of fodder from typical areas.

(*iii*) Introduction of new grasses, legumes, edible shrubs, etc.

(*iv*) Prevention of erosion by "bunding" and other simple methods.

(*v*) Provision of a well-distributed supply of drinking water.

(*vi*) Pasture management including controlled and rotational grazing, fencing, etc.

(*vii*) Possibilities of fodder conservation—dry storage and ensilage.

(*viii*) The restriction, where possible of the number of permits issued for grazing, so as to allow of the proper development of the area and preservation of desirable grasses.

(*ix*) The permanent protection of all animals against rinderpest before permits are issued.

(*x*) The castration of all scrub bulls with two teeth or over, unless an enhanced grazing fee is paid.

Before the above improvements can be introduced on a scale sufficiently large to make any appreciable contribution to the food problem in India, however, it will be necessary to investigate the question of re-classifying the existing land, as recommended by the Royal Commission on Agriculture, and this having been done, the next step will be to assign to one department, or division of a department, the duty of developing the areas set apart for grazing to their fullest capacity.

FEEDING AND HANDLING EXPERIMENTS ON THE PUSA PEDIGREE SAHIWAL HERD (THIRD REPORT, 1934-35)

BY

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Two previous reports, each covering the period of a year, 1932-33 and 1933-34, have already been published in *Agriculture and Live-stock in India*, Vol. IV, Parts II and V, 1934, and this report covers the final year 1934-35 of the test and gives the conclusions arrived at from the careful examination of the whole experiment.

The year under report was normal for the greater part of the time. Considerable confusion, due to the rebuilding of the milch byre after the earthquake, existed for a couple of months in the early stages, and at the end of January, 1935, an outbreak of foot-and-mouth caused much dislocation among the cows in milk and a heavy mortality among the young calves. The effect of these incidents is not immediately noticeable, but undoubtedly had a certain effect on yield.

MILK YIELD

Four times milking is now standard throughout the herd, and the average milk yield table per cow per day is given here and shows the steady improvement in the entire herd under special handling and four times milking since it was started.

TABLE I

Average milk yield per cow per day

Month	Before special handling							Under special handling		
	1925-26	1926-27	1927-28	1928-29	1929-30	1930-31	1931-32	1932-33	1933-34	1934-35
April	13·2	12·6	12·9	15·3	15·0	13·2	14·0	16·4	17·8	22·0
May	12·5	12·8	12·6	14·9	14·2	14·2	13·5	17·4	19·1	21·9
June	12·2	14·1	13·2	16·2	13·9	15·0	12·8	17·9	19·2	20·4
July	13·1	13·8	11·8	16·1	13·6	14·5	12·8	17·7	17·3	20·1
August	12·8	13·6	11·7	15·0	13·6	13·9	13·3	18·6	16·8	20·2
September	12·3	13·6	12·7	13·9	12·8	12·3	13·5	18·0	16·2	17·7
October	11·8	12·2	11·9	14·9	11·0	11·2	12·4	17·1	16·6	17·1
November	11·9	10·8	10·9	14·1	10·4	10·0	11·2	16·6	16·7	17·8
December	12·0	9·8	11·0	13·9	10·2	11·4	10·8	17·6	18·1	18·8
January	11·5	8·9	11·7	12·8	10·4	14·1	11·5	17·3	18·4	20·0
February	11·4	9·3	11·9	13·4	11·6	14·4	12·2	17·8	18·7	20·3
March	11·0	10·0	12·2	14·3	13·2	14·1	13·9	17·8	21·1	21·1
Average	12·1	11·8	12·0	14·6	12·5	13·2	12·7	17·5	18·0	19·8

Increase in 1932-33 over 1928-29—20·3 per cent
Increase in 1933-34 over 1928-29—23·6 per cent
Increase in 1934-35 over 1928-29—35·8 per cent

It will be noticed that the peak year of ordinary handling was 1928-29, when the average was 14·6 lb., while under special handling the average of 17·5 lb. in 1932-33, 18·0 lb. in 1933-34 and 19·8 lb. in 1934-35 have been produced by the herd, an improvement in milk yield of 20·3 per cent, 23·6 per cent and 35·8 per cent respectively over the peak year 1928-29.

Sterility, holding off and udder trouble

Table II shows that in the year under report, which is the last year of the experiment, we had a single cow cast for sterility and three cows sold for udder troubles (all contracted before the experiment started).

Lalagi No. 596 developed a loose sphincter in 1934, and during the foot-and-mouth outbreak, it was feared that one quarter would be lost altogether through the teat becoming blocked, but after her present calving that quarter has corrected itself and is now functioning normally. Four times milking which acted as a massage and helped in the absorption of the occluded matter, appears to have saved this valuable cow from losing a quarter.

TABLE II

Sterility, holding off and udder trouble in the Sahiwal herd

1931-32. No. of cows in the herd 88			1932-33. No. of cows in the herd 100			1933-34. No. of cows in the herd 92			1934-35. No. of cows in the herd 92		
Cows sold for :		Cows with udder trouble retained	Cows sold for :		Cows with udder trouble retained	Cows sold for :		Cows with udder trouble retained	Cows sold for :		Cows with udder trouble retained
Sterility and holding off	Udder trouble		Sterility and holding off	Udder trouble		Sterility and holding off	Udder trouble		Sterility and holding off	Udder trouble	
Ajita 1928	...	Hasni 1927	Garbi 1930	Hasni 1927	Sampati 1928	Balki 1931	Machli 1928	Sampati 1928	Dugini 1933	Hundi 1928	Sampati 1928
Manji 1928		Sampati 1928	Bisakha 1931	Radki 1928	Hundi 1928		Masia 1930	Hundi 1928		Bani 1929	Mirja 1929
Rasia 1930		Hundi 1928	Bisesari 1931	Birkhi 1929	Machli 1928		Algi 1930	Mirja 1929		Munni 1930	Hanumati 1930
Labhi 1930		Machli 1928			Mirja 1929			Bani 1929			
		Radki 1928			Bani 1929			Hanumati 1930			
		Mirja 1929			Hanumati 1930			Munni 1930			
		Bani 1929			Munni 1930						
		Birkhi 1929			Algi 1930						
		Hanumati 1930			Masia 1930						
		Munni 1930									
		Algi 193									
		Masia 1930									
Total 4	...	12	3	3	9	1	3	6	1	3	3

NOTE.—The year given after the name of a cow shows the commencement of udder trouble or sterility in the animal.

Herd chart

The herd chart (Fig. 1) is given in the same form as in last report. From a perusal of it, the progress made by the herd in the last three years can be gauged. The increase in the number of 8,000 lb. cows is very marked, and it is in the case of these cows that the effect of the four times milking is most marked. A definite policy of weeding out below 4,000 lb. has now been started, and the majority of the herd are now on the 6,000 lb. mark or higher. Compared with 1934, the number of 8,000 lb. cows has increased from 5 per cent to 19 per cent; above 7,000 lb. decreased from 13 per cent to 11 per cent and above 6,000 lb. from 28 per cent to 26 per cent; while those above 5,000 lb. increased from 16 per cent to 21 per cent and those below 4,000 lb. decreased from 31 per cent to 17 per cent.

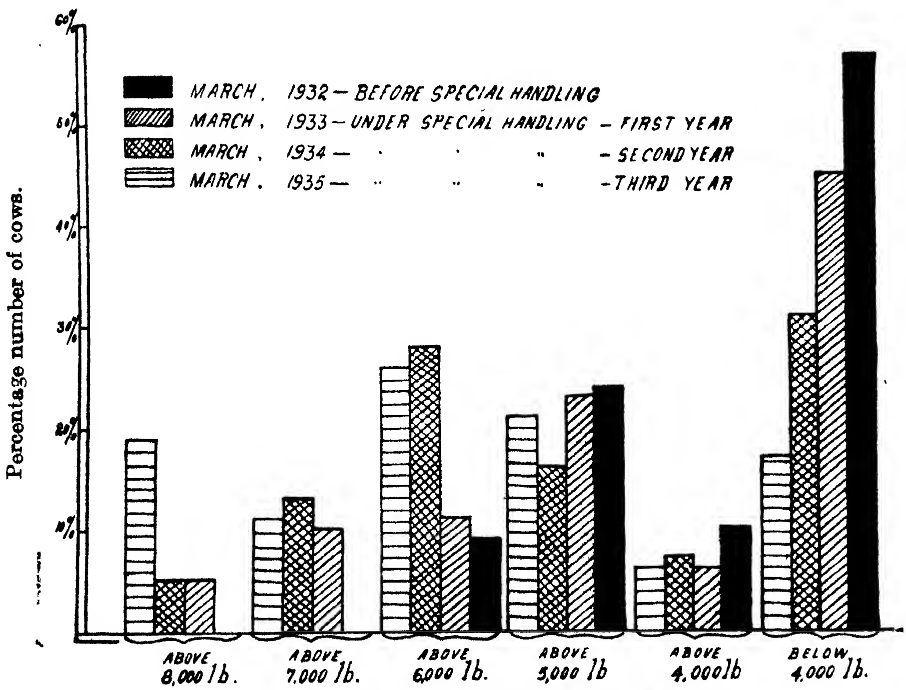


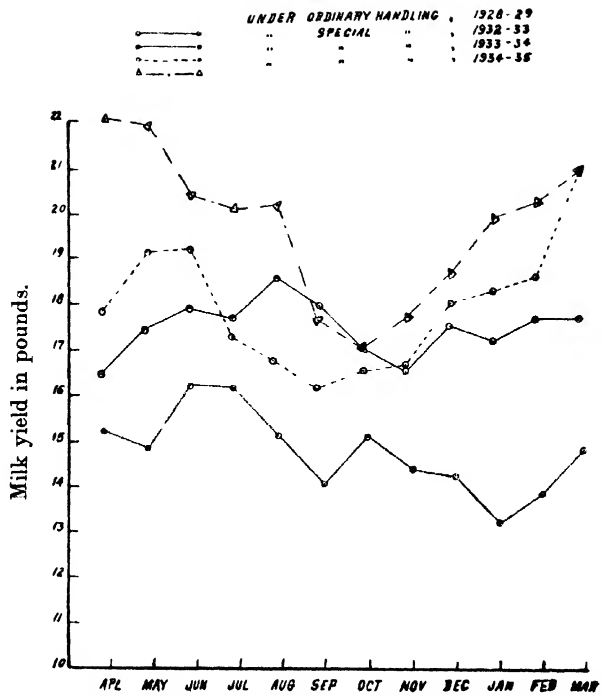
Fig. 1.—Herd chart for March 31st, 1932, 1933, 1934 & 1935.

Results

The results of the experiment may now be summed up:

(1) The increase over the best year under ordinary handling was maintained, and a percentage of 35·8 obtained as against those of 20·3 shown in 1932-33 and 23·6 the figure for 1933-34.

(2) Plate V shows that September, October and November are still the three lowest yield months and in the three seasons of the experiment. November was lowest for 1932-33, September for 1933-34 and October for 1934-35.



Average milk yield per cow per day

A combination of circumstances, connected with calving and the food supply (grazing) seems to be the governing factor for yield in these months.

(3) The experiment of four times milking was started from the 1st April, 1932. Consequently some cows which were already in milk had a portion of their lactations under ordinary handling and the rest under special handling treatment. In the First Report, in comparing the milk yield under special handling of such cows with their previous best yield, the complete lactation could naturally not be taken, but only those weeks corresponding to the special handling lactations could be considered. Again, at the time of writing the Second Report, some of these cows had not completed their second special handling lactations : so the yield obtained during the weeks under special handling lactation had to be compared with those of the corresponding weeks of the first special handling lactation and the previous best lactation. Such cases were also encountered in the third year, and as such it is evident that different periods of lactations had to be dealt with in the two previous reports and this accounts for the variations of the averages in the same lactation of an animal.

The milk-yield figures population was started with 49 cows in the first report. It went down to 37 in 1933-34 (second report) from sales, failure to calve in period and mortality. Now at this stage, data are available for three complete special handling lactations of 13 cows, and the procedure of comparing complete lactations has been adopted.

Table III (*a*) now given shows the comparison of milk yield of thirteen cows under the special handling treatment for three complete lactations together with their previous best lactation. Table III (*b*) shows the milk yield of thirteen *selected best cows* under ordinary handling before the experiments were started.

TABLE III (*a*)

Milk yield of cows under special handling experiment

Name and No. of cows	Date of calving	Service period (days)	Milk yield (lb.)	Wet period (days)	Average yield per day (lb.)	Order of lactations	Handling	Remarks
1. Ajbi 567 . .	20th Sept. 1930 .	266	4014	303	13·2	1	Ordinary	Previous best lactation.
	20th March 1932 .	123	8060	306	26·3	2	Special .	11 days under ordinary handling after second calving.
	6th May 1933 .	178	8015	304	26·4	3	,,	
	11th August 1934	293	7363	304	24·2	4	,,	
2. Amba 495 .	8th May 1928 .	195	5411	304	17·8	2	Ordinary .	Previous best lactation.
	10th Dec. 1932 .	94	6007	304	19·8	6	Special	
	30th Dec. 1933 .	73	8486	304	27·9	7	,,	
	27th Dec. 1934 .	204	8037	304	26·4	8	,,	
3. Atuly 480 .	8th Jany. 1930 .	176	5784	304	19·0	3	Ordinary .	Previous best lactation.
	6th April 1932 .	75	4983	306	16·3	5	Special.	
	3rd April 1933 .	71	6609	306	21·6	6	,,	
	30th March 1934 .	240	6507	306	21·3	7	,,	
4. Chandra 456 .	13th March 1926 .	91	5109	306	16·7	1	Ordinary .	Previous best lactation.
	12th Jany. 1932 .	168	6290	305	20·6	6	Special .	79 days under ordinary handling after sixth calving.
	10th April 1933 .	68	6023	306	19·7	7	,,	
	28th March 1934 .	347	5111	306	16·7	8	,,	
5. Chandrama 569 .	11th April 1930 .	230	3077	306	10·1	1	Ordinary .	Previous best lactation.
	25th Sept. 1932 .	70	6604	303	21·8	3	Special	
	27th Sept. 1933 .	131	6029	304	19·8	4	,,	
	14th Nov. 1934 .	121	8015	306	26·2	5	,,	
6. Chengi 534 .	14th Jany. 1931 .	190	6681	304	22·0	2	Ordinary	Previous best lactation.
	5th May 1932 .	3[illegible]7	7901	304	26·0	3	Special	

	9th March 1934	110	8035	306	26·3	4	„	
	11th April 1935	234	7356	306	24·0	5	„	
7. Lakhni 587	28th June 1931	103	5582	305	18·3	1	Ordinary	Previous best lactation.
	27th July 1932	51	7017	304	23·1	2	Special	34 days under special handling at the end of first lactation.
	1st July 1933	98	7009	304	23·1	3	„	
	16th July 1934	175	6413	305	21·0	4	„	
8. Makhi 557	27th Jany. 1931	141	5478	303	18·1	2	Ordinary	Previous best lactation.
	2nd April 1932	80	7226	306	23·6	3	Special	
	31st March 1933	58	7082	306	23·2	4	„	
	11th March 1934	150	8049	306	26·3	5	„	
9. Mukta 472	18th Nov. 1930	207	5536	304	18·2	3	Ordinary	Previous best lactation.
	19th March 1932	94	7254	306	23·7	4	Special	12 days under ordinary handling after fourth calving.
	10th April 1933	361	6909	306	22·6	5	„	
	21st Jany. 1935	357	5946	304	19·6	6	„	
10. Muraee 547	26th July 1930	98	4492	304	14·8	2	Ordinary	Previous best lactation.
	6th Nov. 1932	123	6937	304	22·8	4	Special	
	22nd Dec. 1933	82	8032	304	26·4	5	„	
	24th Dec. 1934	136	7567	304	24·9	6	„	
11. Ramati 566	28th Feb. 1931	180	5066	306	16·6	1	Ordinary	Previous best lactation.
	1st June 1932	108	8863	304	29·2	2	Special	
	29th June 1933	77	8327	304	27·4	3	„	
	24th June 1934	135	6001	308	19·5	4	„	
12. Rikha 586	20th Dec. 1930	120	3150	304	10·4	1	Ordinary	Previous best lactation.
	30th Jany. 1932	168	5655	304	18·6	2	Special	61 days under ordinary handling after second calving.
	27th April 1933	74	6049	304	19·9	3	„	
	21st April 1934	108	5327	306	17·4	4	„	
13. Chakai 563	6th July 1930	302	1255	271	4·6	1	Ordinary	Previous best lactation.
	17th Feby. 1932	129	5957	304	19·6	2	Special	43 days under ordinary handling after second calving
	15th April 1933	87	6899	306	22·5	3	„	
	30th April 1934	137	8001	304	26·3	4	„	

TABLE III (*b*)

Milk yield of selected best cows under ordinary handling

Name and No. of cows	Date of calving	Service period (days)	Milk yield (lb.)	Wet period (days)	Average yield per day (lb.)	Order of lactations
1. Akli 231 .	21st March 1917 .	173	5406	307	17·6	1
	15th June 1918 .	278	4571	305	15·0	2
	27th Dec. 1919 .	167	4886	306	16·0	3
	19th March 1921 .	358	4829	306	15·8	4
	10th Dec. 1922 .	96	4236	304	13·9	5
	20th Dec. 1923 .	170	4590	304	15·1	6
	23rd March 1925 .	172	2752	238	11·6	7
	23rd June 1926 .	318	3549	304	11·7	8
2. Anjani 210 .	15th Sept. 1916 .	156	3679	303	12·1	1
	8th Dec. 1917 .	320	4953	304	16·3	2
	11th August 1919	188	4247	305	13·9	3
	7th Dec. 1920 .	50	3997	281	14·2	4
	11th Nov. 1921 .	77	4346	304	14·3	5
	13th Nov. 1922 .	156	3781	304	12·4	6
	15th Feby. 1924 .	82	4200	304	13·8	7
3. Ashrafi 211 .	9th Dec. 1916 .	497	3231	304	10·6	1
	29th Jany. 1919 .	400	4217	304	13·9	2
	23rd Jany. 1921 .	48	3332	295	11·3	3
	18th Dec. 1921 .	198	4670	304	15·4	4
	22nd April 1923 .	290	4429	306	14·5	5
	17th Nov. 1924 .	61	3368	288	11·7	6
	28th Oct. 1925 .	356	3714	304	12·2	7
	7th August 1927 .	..	2646	305	8·7	8
4. Hanumati 399	11th March 1923 .	132	3357	306	11·0	1
	1st May 1924 .	175	4848	304	15·9	2
	16th June 1925 .	55	4105	293	14·0	3
	25th May 1926 .	83	5406	304	17·8	4
	26th May 1927 .	249	6190	305	20·3	5
	6th Nov. 1928 .	265	5649	304	18·6	6
	8th May 1930 .	212	5327	304	17·5	7
5. Imani 138 .	29th Sept. 1914 .	162	4466	303	14·7	1
	28th Dec. 1915 .	422	6200	306	20·3	2
	8th Dec. 1917 .	381	5654	305	18·5	3
	12th Oct. 1919 .	401	4066	306	13·3	4
	27th August 1921	150	4882	303	16·1	5
	5th Nov. 1922 .	263	3915	304	12·9	6
6. Joogni 142 .	14th August 1914	144	4100	304	13·5	1
	19th Oct. 1915 .	235	4667	305	15·3	2
	26th March 1917 .	438	5464	307	17·8	3
	14th March 1919 .	312	6456	307	21·0	4
	28th Oct. 1920 .	435	6054	304	19·9	5
	18th Oct. 1922 .	..	5777	304	19·0	6

TABLE III (*b*)—*contd.*

Milk yield of selected best cows under ordinary handling

Name and No. of cows	Date of calving	Service period (days)	Milk yield (lb.)	Wet period (days)	Average yield per day (lb.)	Order of lactations
7. Kadambri 243	19th Oct. 1918 .	316	3691	305	12·1	1
	12th June 1920 .	86	5064	304	16·7	2
	23rd June 1921 .	109	3720	304	12·2	3
	22nd July 1922 .	242	4519	304	14·9	4
	11th Jany. 1924 .	185	6347	296	21·4	5
8. Kamli 312 .	4th Jany. 1921 .	100	5785	304	19·0	1
	2nd Feby. 1922 .	134	4515	303	14·9	2
	27th March 1923 .	174	6817	306	22·3	3
	27th June 1924 .	103	5848	304	19·2	4
	23rd July 1925 .	90	7053	306	23·1	5
	5th August 1926 .	103	2851	304	9·4	6
	5th Sept. 1927 .	64	6590	304	21·7	7
	19th August 1928.	88	5620	304	18·5	8
9. Milapi 263 .	21st August 1919	247	4181	304	13·8	1
	11th Feby. 1921 .	338	4732	303	15·6	2
	27th Oct. 1922 .	138	5093	304	16·8	3
	29th Dec. 1923 .	182	4897	305	16·1	4
	14th April 1925 .	161	4168	280	14·9	5
	12th July 1926 .	286	3638	279	13·0	6
	4th April 1928 .	..	6395	306	20·9	7
10. Mina 338 .	24th Nov. 1921 .	155	3890	304	12·8	1
	19th Feb. 1923 .	92	4158	303	13·7	2
	28th Feby. 1924 .	121	4334	307	14·1	3
	3rd April 1925 .	83	4414	306	14·4	4
	2nd April 1926 .	95	4103	306	13·4	5
	22nd April 1927 .	85	4879	306	15·9	6
	28th April 1928 .	115	3852	304	12·7	7
11. Roomali 140 .	9th July 1914 .	251	3657	310	11·8	1
	3rd Jany. 1916 .	235	4883	305	16·0	2
	7th June 1917 .	438	4711	304	15·5	3
	31st May 1919 .	441	5007	304	16·5	4
	10th June 1921 .	223	2693	304	8·9	5
	2nd Nov. 1922 .	..	3412	305	11·2	6
12. Sampati 311 .	5th Feby. 1921 .	385	3959	303	13·1	1
	9th Dec. 1922 .	193	4724	303	15·6	2
	30th March 1924 .	104	5213	306	17·0	3
	22nd April 1925 .	133	4619	306	15·1	4
	18th June 1926 .	64	5138	304	16·9	5
	3rd June 1927 .	162	4136	305	13·6	6
	19th August 1928	418	5093	304	16·8	7
	16th July 1930 .	736	4591	304	15·1	8

TABLE III (*b*)—*concld.*

Milk yield of selected best cows under ordinary handling

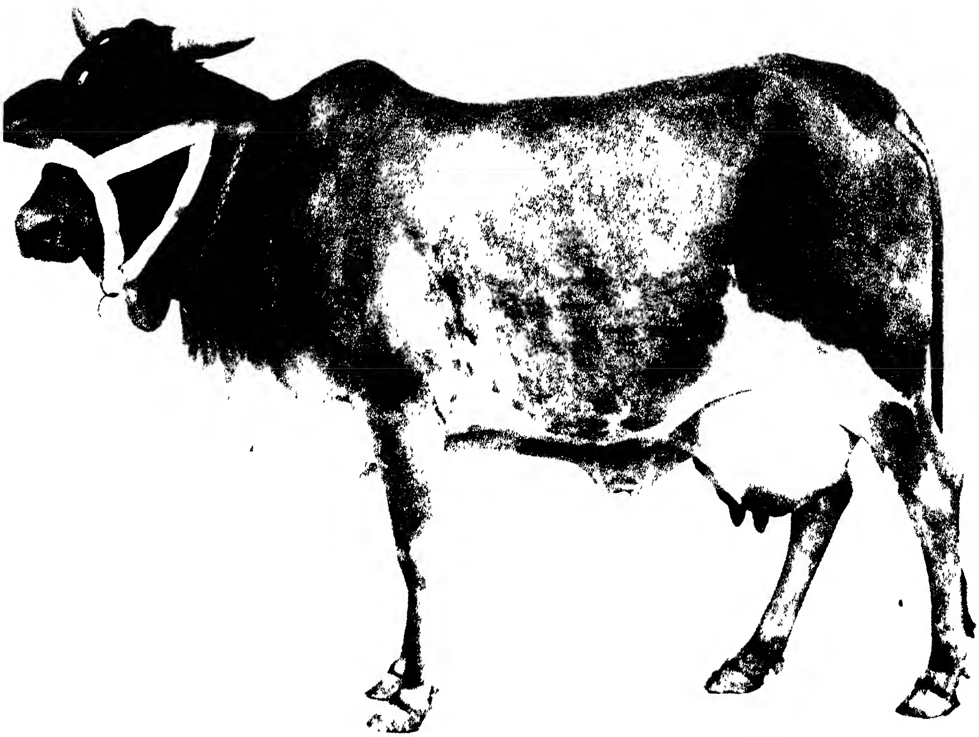
Name and No. of cows	Date of calving	Service period (days)	Milk yield (lb.)	Wet period (days)	Average yield per day (lb.)	Order of lactations
13. Tutia 318 .	6th Jany. 1921 .	150	4217	304	13·9	1
	14th March 1922 .	124	4029	306	13·2	2
	28th April 1923 .	68	4880	305	16·0	3
	12th April 1924 .	179	5252	296	17·7	4
	22nd July 1925 .	149	5865	292	20·1	5
	27th Sept. 1926 .	125	3807	304	12·5	6
	17th Nov. 1927 .	87	5346	301	17·8	7
	23rd Nov. 1928 .	467	5196	304	17·1	8

Table III (*c*) gives the average milk yield per day in different lactations of cows dealt with in Table III (*a*) and Table III (*b*).

TABLE III (*c*)

Comparison of average milk yield per day in different lactations of cows under special and ordinary handling

Order of lactations	Average milk yield per day in lb. (complete wet period taken)		Percentage increase over ordinary handling
	Ordinary handling	Special handling	
1	13·54	..	..
2	15·57	23·36	50·03
3	15·82	23·83	50·63
4	16·27	22·42	37·80
5	16·74	23·63	41·16
6	13·79	21·29	54·39
7	16·21	22·94	41·52
8	14·20	21·55	51·76



Sahiwal cow 'Brisoorti' No 609 under special handling

Milk yield in the first lactation—6,036 lb.
Milk yield in the second lactation—8,009 lb.

Sahiwal cow 'Laruli' No 604 under special handling

Milk yield in the first lactation—7,648 lb.
Milk yield in the second lactation—8,823 lb.

From Tables III (*a*), III (*b*) and III (*c*), it is clear that special handling has produced a marked effect in improving the milk yield of our cows. The cows under the experiments were not selected for the purpose, and we have compared the yield of these cows with our *selected best* milkers under the old regime before the experiments were started. This proves conclusively that four times milking has definitely produced an increased milk yield.

It may be of interest here to see the improvement among heifers in a similar period and the table of yield of four is given.

TABLE IV

Milk yield of some of the heifers under special handling

Name and brand No.	Average milk yield per day in lb. (complete wet period taken)		
	First lactation	Second lactation	Third lactation
Birengee 631	12·3	20·9	..
Brisoorti 609	19·9	26·2	..
Lachrama 612	14·0	18·9	20·2
Laruli 604	25·2	29·0	30·1

The following cows were sold off during the year under report from the previous list of thirty-seven taken under special handling. They averaged Rs. 125 apiece and were all sold in milk.

Algi, Ankhi, Bani, Bulki, Chanee, Masia, Munni, Ramsakhia, Roochi and Aruli.

They had all shown marked improvement, and it is of interest to see that cows like Algi whose previous best was 9·7 lb. and value about Rs. 70 fetched Rs. 130 when doing 21·3 lb., while Bulki whose value was about Rs. 100 at 12·9 lb. fetched Rs. 200 at 31·5 lb. and Ramsakhia who went from 8·8 lb. to 22·8 lb. fetched Rs. 200 when sold. All these cows were drafted in accordance with the herd policy which limits our numbers to the amount we can feed on the Estate.

(4) The cost in concentrate per pound of milk remains practically the same as last year and the reduction in cost is maintained.

In Table V, cost of concentrate per pound of milk has been shown. Before these experiments were started, every cow used to get one pound of concentrate for two pounds of milk. Now, under the experiment, a milch cow is fed at the rate of one pound concentrate for three pounds of milk. From these data the difference in the concentrate cost per pound of milk is easily seen.

TABLE V

Cost of concentrate per pound of milk calculated over the whole herd

Period	Average No. of cows in the herd (per month)	Total amount of concentrate consumed (lb.)	Total yield of milk (lb.)	Cost of concentrate per lb. of milk at Rs. 2-8-0 per 82 lb. (pies).
April 1931 to March 1932	56	131,680	340,754	2·26
April 1932 to March 1933	46	97,237	300,987	1·89
April 1933 to March 1934	45	101,810	294,323	2·02
April 1934 to March 1935	34	85,040	247,676	2·00

(5) There was no increase in the general expenses.

(6) The mean successful service period in the herd rose from 90 to 159 days. The increased yields given have necessitated the establishment of a definite service period linked with yield. Thus a heifer giving over 6,000 lb. is kept back until the 140th day, while a cow giving 8,000 lb. or over is kept back to 150, as allowing such heavy yielders to go to bull earlier did not always meet with success ; and it would appear necessary in a heavy-yielding herd to establish a service period according to yield and conditions.

TABLE VI

Mean service period of the Sahiwal cows in the test

Period	Number of cows	Mean service period (days)	Standard error of mean
April 1931 to March 1932	44	172	17·09
April 1932 to March 1933	44	94	9·39
April 1933 to March 1934	62	90	6·10
April 1934 to March 1935	39	159	11·78

In the above table we have only used those animals which were covered in the year under report. This has caused variation in the population in different years.

(7) Body-weight figures of the cows in the experiment show an average of 858 lb. in the second year against 820 lb. in the first. In the third year most of the cows had yet to finish their lactation.

TABLE VII

Body-weight of cows under special handling

Serial No.	Name of cow	No. of lactations completed before special handling	Weight in lb. at the completion of each special handling lactation (10 months)		
			First lactation	Second lactation	Third lactation
1	Ajbi	1	895	934	1,011
2	Algi	3	820	867	..
3	Amba	4	899	854	871
4	Atuly	4	..	817	764
5	Bansuri	..	805	815	866
6	Brisoorti	..	745	791	..
7	Chandra	5	928	1,028	956
8	Chandrama	2	895	982	989
9	Chandrika	3	639	647	..
10	Chakai	1	740	758	786
11	Chapla	5	828	*746	867
12	Chengi	2	832	925	871
13	Dubla	..	854	*766	..
14	Lachrama	..	758	754	..
15	Lakhni	1	916	1,048	760
16	Lalagi	..	828	876	..
17	Lalita	1	740	884	..
18	Laruli	..	746	850	..
19	Makhi	2	943	953	973
20	Mopati	..	729	784	..
21	Mukta	3	881	850	970
22	Munnie	5	848	940	..
23	Muraee	3	830	927	909
24	Nasoorti	6	785	779	*621
25	Rabri	2	727	788	..
26	Ramati	1	783	877	919
27	Rikha	1	943	1,002	1,068
28	Roopwati	3	822	807	..
	Average		820·7	858·9	..

*Sick.

(8) The average butter-fat percentage shows fully upto the previous two years of the experiment and an improvement on 1929-30 and 1930-31.

Table VIII

Butter-fat percentage in composite sample

Month	Under ordinary treatment					Under special treatment		
	1927-28	1928-29	1929-30	1930-31	1931-32	1932-33	1933-34	1934-35
April	..	4·3	4·6	4·6	4·6	4·6	4·5	4·8
May	..	..	4·4	4·4	..	5·0	4·1	4·8
June	..	..	4·4	4·5	..	4·6	4·5	4·7
July	4·5	..	4·5	4·5	..	4·5	4·4	4·8
August	4·3	..	4·4	4·6	..	5·0	4·4	4·8
September	5·1	..	4·2	4·7	..	4·6	4·2	4·8
October	5·0	..	4·6	4·8	..	5·1	4·7	4·7
November	4·6	4·5	4·9	4·7	..	5·5	4·8	4·9
December	4·6	5·0	4·9	4·9	..	5·3	4·7	5·1
January	4·6	4·7	4·8	4·7	..	5·4	5·2	5·1
February	4·5	4·8	4·9	4·4	..	4·6	5·0	5·0
March	4·6	4·5	4·6	4·6	..	4·3	4·7	5·0
Average	..	..	4·6	4·6	..	4·9	4·6	4·9

Calf mortality figures

Here it is necessary to record another heavy increase in mortality which rose from 10·3 per cent in 1933-34 to 27·4 per cent in 1934-35. The deaths of eleven calves from foot and mouth and three from mica poisoning have caused the rise which has no connection with the system of pail feeding used here.

Table IX

Calf mortality figures

Period	No. of calves	Mortality per cent
April 1931 to March 1932	70	4·3
April 1932 to March 1933	69	1·4
April 1933 to March 1934	78	10·3
April 1934 to March 1935	62	27·4

The comparative weight table of calves dropped before and after special handling is given here. The figures show no decrease from those available before special handling.

TABLE X

Calf weight at birth

Serial No.	Dam	Weight of calves in lb. born to cows: Before special handling lactation	Under special handling at the completion of: One lactation	Two lactations
1	Ajbi	43	57	52
2	Atuly	48	51	53
3	Bansuri	42	49	51
4	Dubla	51	65	47
5	Lachrama	47	51	50
6	Lakhmi	41	47	53
7	Lalagi	46	51	40
8	Lalpari	45	43	39
9	Laruli	42	45	50
10	Latwali	51	58	45
11	Makhi	48	68	63
12	Mopati	37	53	46
13	Ramati	46	53	38
14	Ramsakhila	47	47	51
15	Rajendri	37	47	45
16	Reba	43	51	48
	Average weight	44·63	52·25	48·19

It is here necessary to add for the enlightenment of those relying purely on statistical analysis that in an experiment of this nature conducted with a milch herd, it is not possible to have the same population year after year. All those familiar with cattle-breeding will know that it is impossible to exercise complete control over the calving down of a herd, and as a result it is not always possible to have the same number of animals in a corresponding condition each year

GENERAL ANALYSIS

We have now had three years' experience of the method of handling and feeding enunciated in the first report and are able to judge of the general results throughout the herd. The method is now standard throughout the herd, which may be considered to be the verdict upon it, as far as the Pusa herd is concerned It has received a very long and thorough trial, and during that trial a number of points have been brought to light which need further elucidation, and investigation on them is now being conducted.

The system has proved itself during the three years it has been investigated and has definitely shown the following advantages :

(*i*) It has raised the herd yield.

(*ii*) It has reduced the cost per pound of milk.

(*iii*) It has not increased the general expenses on the herd.

(*iv*) No general ill effects either in loss of weight, udder trouble, sterility or standing off have been noticed.

(*v*) The standard of calves produced has been fully maintained.

(*vi*) It has proved itself the most efficient method of testing the milk capacities of all cows.

At present the following points which have been raised by the above investigation require further elucidation.

1. The necessity for individual rationing in certain cases.

2. Effect of four times milking on the body-weight of certain cows.

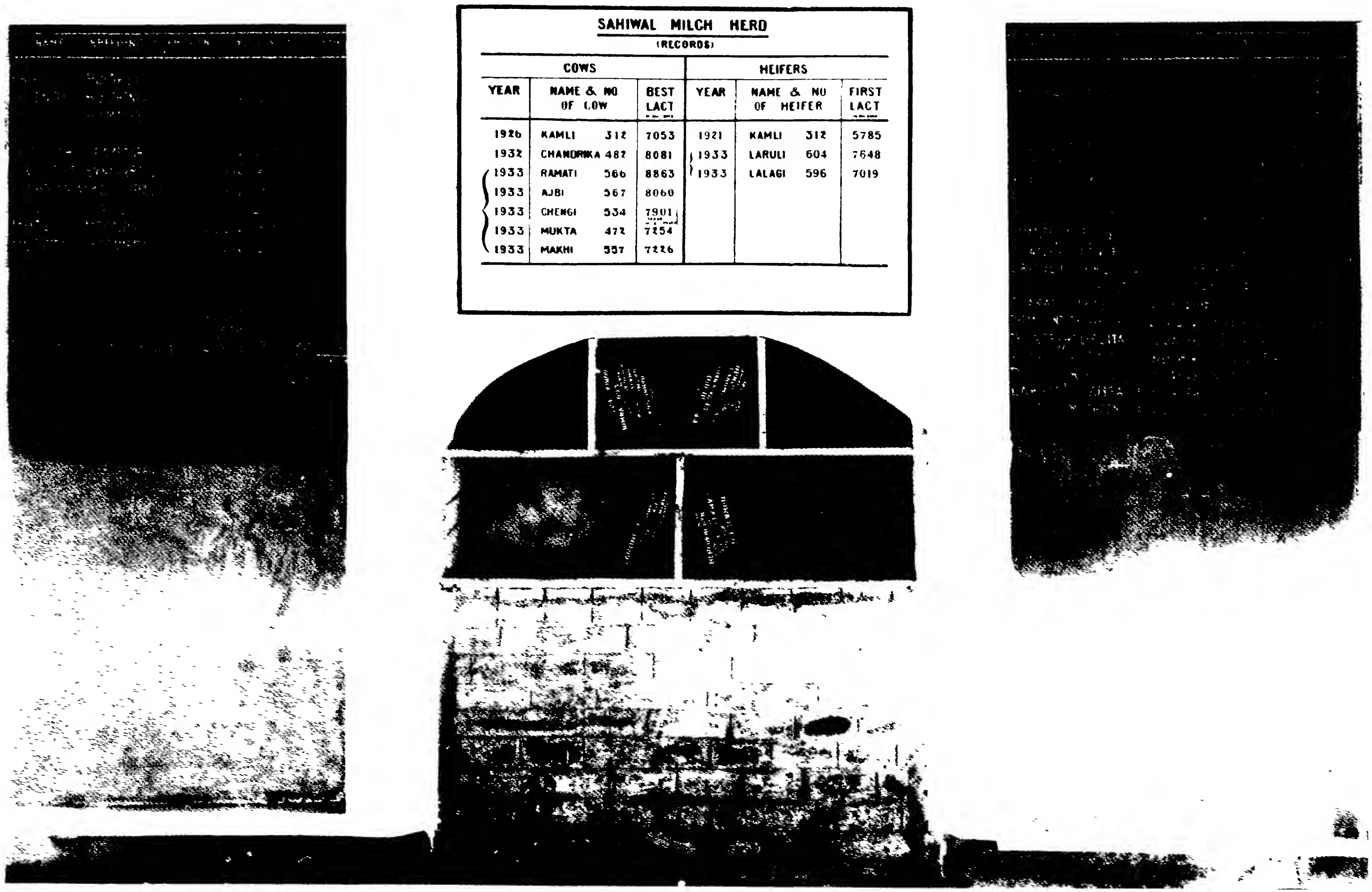
3. Effect of four times milking on the subsequent lactations of certain cows.

4. The necessity for correlating with the increased yields obtained a longer service period for high-yielding cows.

Point (*i*).—Individual rationing. Here although the general milch average of the herd has risen, yet some cases of cows which have been unable to keep condition on the standard ration have occurred, which point clearly to the fact that in these cases the standard rationing is not satisfactory. That it will be possible to ration such individual cases to answer to these high yields, I have not the shadow of a doubt. It is being done in other countries, and its determination in India is only a course of time. At present, however, if a cow requires 4 oz. of some essential substance and has to consume 10 lb. of other food to obtain it, the chances are that she will never obtain balance except at the cost of her digestion and under present conditions will be far too expensive a cow to feed. In England a cow giving 140 lb. a day can obtain the correct ration from about 45 lb. of some special known mixture and keep her condition. To obtain similar results in India at present I calculate the cow would have to consume considerably more than that amount and even then might not keep condition.

A summary of all these cases can only lead to one conclusion. Yield is now in advance of rationing and further progress in certain cases must wait on proper rationing. The standard accepted ration 3½-10 obviously lacks in certain cases the essential elements to keep the cow in balance.

Point (*ii*).—The condition of certain cows has clearly shown that the standard ration supplied was lacking in certain definite ingredients demanded by those animals and so was not sufficient to meet the demands made by the higher yields produced under the new system. Such cows lost weight, became tucked up and tired looking, and though they milked out to the end, required a longer rest period to enable them to regain normal.



Lactation board (Photographed in 1933)

Points (iii) and (iv).—In other cases a drop in the subsequent lactation of a marked order was shown. This did not accompany any loss of condition, but appeared to be an enforced 'slow down'. It was anticipated from the start that it would probably be found that all very high-yielding cows would probably show the usual reluctance in the early stages to hold to bull. This has been so and in most high-yielding cases the rest period has been considerably lengthened, a condition of things found in all high-yielding herds.

At the conclusion of this report it will not be out of place to emphasise the necessity of both staff and cattle being properly trained for the carrying out of such work.

At Pusa the staff are highly skilful milkers, and all the young stock and almost all the milch cows are so well trained that they can be handled and examined by any one without the least trouble whether they are being milked or not. This state of things has taken sometime to secure, and even now we still have a couple or so of old cows who are not absolutely steady in the byre—a relic of the old regime. The rationing is very carefully done and the rations are of the best quality, while each cow's yield is tabulated daily on a board against the similar week's average in her previous best lactation making it possible to detect instantly any falling off in yield and examine the reason.

Any dairy farm desirous of duplicating this work on their own herd should carefully see that the above conditions are fulfilled. Inefficient milking, cattle which are wild or shy in the byre and mediocre rationing are things which will nullify any attempts to improve milk yields by the methods advocated in these articles, and these points should be remedied, where necessary, in all cases before work on the above lines is attempted.

YIELD OF CHEDDAR CHEESE IN RELATION TO THE FAT PERCENTAGE IN MILK

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INTRODUCTION

CHEDDAR cheese is a product which can be made either from cow's or buffalo's milk by bringing the larger part of the milk solids together into a condensed form by coagulation of the casein and the expulsion of a part of the water. The chief object of cheese-making is to preserve the valuable constituents of milk in a permanent, palatable and easily marketable form. A portion of the milk sugar, albumin, fat and ash are lost but all other nutrients are preserved. The only constituent which is intentionally eliminated is water.

The relation between the chemical composition of milk and the yield of cheese is of great importance to the cheese-maker. The amount of fresh cheese obtained from a given quantity of milk will depend primarily on the percentage of solids in milk, the percentage of solids lost in the whey and the amount of moisture retained in the curd. Of all the milk solids which are of great importance and which affect the yield of cheese, are fat and casein. These two constitute over 90 per cent of the solids in cheese. Of course small amounts of milk sugar and albumin are retained in the cheese, but as they are in such a small proportion they do not affect the yield of cheese.

In general, the percentage of casein in milk bears a quite definite relation to the percentage of fat, but the ratio between the two is not constant, *i.e.*, in milk that is richer in fat, casein does not increase in the same proportion as fat. For example, it was found that if milk contained 3 per cent fat, the cheese contained 2·1 per cent casein, while the cheese obtained from milk containing 4 per cent fat was found to contain 2·5 per cent casein on an average. In rich milk the ratio of casein to fat is slightly lower than in milk lower in fat content. Since the percentage of fat is the most variable solid in milk, the yield of cheese should be in nearly direct ratio to the fat content of milk.

In the United States of America and Europe, cheese is made from milk containing between 3 to 4·5 per cent fat. It is believed that anything above 4 per cent fat is wasted in whey. Since the fat content of Indian cow's milk is in many cases higher than 3·5 to 4 per cent, it was thought necessary to determine experimentally whether it was desirable to standardise the milk to 4 per cent fat to prepare cheese profitably, or whether it was possible to manufacture cheese of good quality with increased fat content. With this end in view, different lots of milk containing varying amounts of fat beginning with 0·1 per cent and going upto 6·5 per cent with a gradual increase of 0·5 per cent each time, were used for preparing cheese, and their outturn and quality recorded.

Experimental

Since cheese-making is mainly a process of fermentation and since the milk used for cheese-making is not usually pasteurized, it is absolutely necessary that the milk meant for cheese-making should be produced under most hygienic conditions. It has been truly said that the cheese-making really begins at the drawing of the milk from the cow and the success of the process and the quality of the cheese primarily depends upon the conditions under which the milk is drawn, and its subsequent handling and keeping it free from dirt and bacteria. When milk is not properly cared for in the farm, it acquires high acidity, offensive odour, gas formation, etc., which injure its usefulness in cheese-making. In the case of butter-making the cream which contains the greater percentage of fat is separated and the chances of getting offensive taints from the milk are very little. But with cheese the finished product can easily be spoilt by harmful bacteria and offensive flavours in milk, and hence the milk used for cheese should be produced under very clean conditions. Cows should not be fed with strong smelling feeds like cabbages, turnips, silage, etc., since these are sure to impart strong taints to milk and thus lower the quality of cheese.

The procedure adopted for making cheese in the present studies is as follows : After satisfying oneself as to the suitability of milk for cheese-making, it is divided into evening milk and morning lots. As soon as the evening milk is received it is cooled down to 45° F and put into a cheese vat and held at a temperature of 60° F throughout the night. Next morning the top layer of the overnight's milk is skimmed off since the fat has risen to the top during the night. This cream is then warmed up to about 95° F and then put back into the milk. Morning milk is added to the overnight milk and the acidity of the mixture then determined. Clean flavour starter specially prepared for cheese-making is then introduced into the milk in the vat and the acidity is allowed to rise. Next the milk is brought to renneting temperature and the rennet is added. The action of the rennet is to coagulate the casein, thereby enveloping the fat in it. This coagulum is allowed to stand undisturbed for about forty minutes in order to get firm and is then cut by special cheese knives into small regular-sized cubes and the whey is

separated. The cubes at this stage are very soft and should be handled very carefully, since careless cutting and rough handling results in a loss of fat which passes out in the whey. These cubes are cooked to about 100° F when the acidity also increases. When a certain firmness and acidity are attained the whey is drained out and the cubes are allowed to fuse together to form a big loaf. When the desirable texture and acidity are reached these loaves are milled into small pieces, so that they can be easily salted and put in the moulds to give the required shape and size. These green cheese pieces are brought back to the vat and are aerated for a short time to get rid of undesirable flavours if any. They are then salted and put into cheese moulds and then under the press. The following day the cheese is scalded, bandaged, etc., and on the third day it is removed to the curing room where after about two to two and half months, it is ready for the market. The by-product whey is a very good fattening food for stock, since it contains large amounts of the milk sugar. So it is generally used for feeding poultry, pigs, etc.

In manufacturing cheese from milk containing different percentages of fat it was found necessary to vary the process to a certain extent, and although the agents, and their quality used in the manufacture of the cheese throughout the experiment remained the same, the stages like maximum cooking, temperature, softness of the curd before drawing out the whey, quantity of rennet, etc., had to be varied according to the condition of milk and the development of acidity and texture of the curd. Table I will show details of the process employed for the manufacture of each cheese.

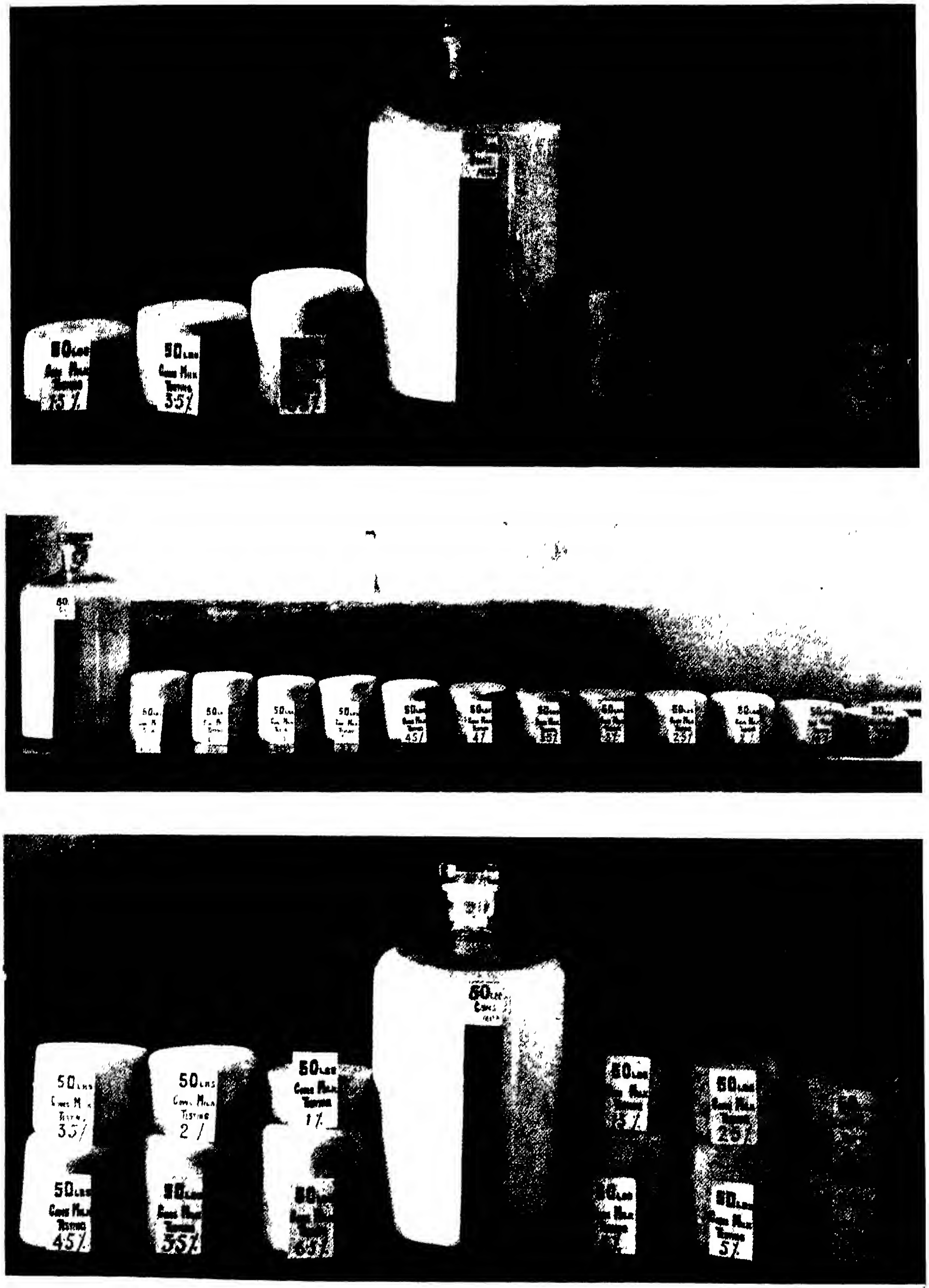
Plate IX gives a good idea of the outturn of cheeses from various fat percentages contained in the milk used.

When the above cheeses ripened they were judged by the Imperial Dairy Expert, and his remarks about the quality of the cheeses are recorded in Table II.

Discussion

From Table II it will be noticed that the cheeses from milk of high fat percentages were soft and greasy in body and texture, while those manufactured from milk containing 3·5 to 5 per cent fat were very good in texture with a mellow feel and they had developed the characteristic cheddar cheese flavour. All samples under 3·5 per cent fat were crumbly in texture and had developed a pronounced acidic flavour. So from the point of view of quality, cheeses from milk containing 3·5 to 5 per cent fat were the best. Above 5 per cent, they were greasy and soft in texture and had developed a very mild flavour.

Perusal of Table III will show that the net profit goes on decreasing as the fat percentage in milk increases. For example net profit from 1 per cent fat is Rs. 2-7-10, whilst that from 3 per cent fat is Rs. 2-2-10 and from 6 per cent fat is Rs. 1-4-6. This shows that it is more economical to manufacture cheese from



Outturn of cheeses from various fat percentages contained in the milk

milk containing low percentage of fat, but it must be borne in mind that cheese made from milk containing less than 3·5 per cent fat were crumbly in texture and lacking in that typical cheddar cheese flavour, since the body, texture, flavour and the palatability of the cheese play a great part in determining its quality and value, in the market, it is clear that it is most economical to prepare cheddar cheese from milk containing 3·5 to 5 per cent fat.

One of the most important points to be determined was the total fat lost in the process of manufacture of the above cheeses. After the above cheeses had ripened they were analysed, and Table IV shows how much total fat was lost by first determining the quality of fat contained in the milk and how much remained in the ripened cheese. From this it will be seen that when the percentage of fat in milk was high, more loss of fat resulted in the making of the cheese.

The following statement will show the relative outturn of the cheeses :—

Quantity of milk in lbs.	Percentage of fat	Ripened cheese outturn	Quantity of milk in lbs.	Percentage of fat	Ripened cheese outturn
		lbs. ozs.			lbs. ozs.
50	·1	2 6	50	3·5	4 1
50	1·0	2 14	50	4·0	4 4
50	1·5	3 6	50	4·5	4 9
50	2·0	3 8	50	5·0	4 12
50	2·5	3 12	50	5·5	4 15
50	3·0	3 15	50	6·0	5 2
			50	6·5	5 4

Summary

The results of the experiments showed that cheese made from milk containing 3·5 to 5 per cent fat were the best from the point of view of quality and economy and that in India cheddar cheese can be economically manufactured from milk containing fat in the above proportion.

Our thanks are due to Mr. S. D. Sunawala of the Indian Institute of Science, Bangalore, for very kindly analysing the cheese samples to determine the loss of fat. We have also to express our thanks to the Imperial Dairy Expert, Bangalore, for lending his help in judging the cheeses.

TABLE

Showing details of process

Cheese No.	Milk		Starter		Colour	Renneting			Cutting curd		Cooking the curd			
	Quantity in lbs.	Acidity	Acidity	Quantity	Quantity in c. c.	Acidity at	Quantity in c. c.	Time added	Time	Acidity of whey	Time started	Time finished	Temp. attained	Time settled the curd
				Ozs.									F.°	
189 .	50	0·2	0·87	6	2	0·21	22	7·27	8·0	0·15	8·15	9·0	95	9·5
190 .	50	0·2	0·9	10	2	0·21	20	7·30	8·5	0·15	8·20	9·10	95	9·20
191 .	50	0·2	0·87	10	2	0·21	20	7·30	8·10	0·17	8·25	9·45	99	10·0
192 .	50	0·2	0·97	8	2	0·21	20	7·30	8·15	0·14	8·30	9·50	100	10·5
193 .	50	0·2	1·1	8	2	0·21	20	7·40	8·25	0·15	8·45	9·30	98	9·45
194 .	50	0·2	1·2	8	2	0·21	22	7·45	8·40	0·15	8·50	9·30	100	9·45
195 .	50	0·22	0·73	12	2	0·23	22	7·45	9·0	0·15	9·15	9·15	101	10·40
196 .	50	0·21	0·95	12	2	0·22	22	7·20	8·5	0·16	8·20	9·30	101	9·45
197 .	50	0·2	0·78	12	2	0·22	24	7·30	8·10	0·16	8·20	9·15	102	9·25
198 .	50	0·22	0·89	8	2	0·23	24	7·25	8·5	0·15	8·15	9·20	100	9·30
199 .	50	0·2	0·7	12	2	0·22	22	7·31	8·15	0·12	8·30	10·25	100	10·25
200 .	50	0·2	0·7	1 lb.	2	0·20	22	7·35	8·10	0·14	8·35	9·45	101	10·5
201	50	0·18	0·62	1 lb.	2	0·18	22	7·20	8·10	0·13	8·25	10·0	101	10·20

of manufacture

Drawing the whey		Cheddaring		Milling		Aeration	Salt	Press		G. cheese	Fat per cent	Fat per cent
Acidity at	Time	Time started	Time finished	Time	Acidity at	Time taken	Quantity in ozs.	Chessetting time	Acidity of whey from	Outturn of green cheese	In milk	Lost in whey
						Mts.						
0·2	9·20	9·30	12·30	12·45	0·82	2	1½	1·10	0·89	3-4½	S. M.	...
0·2	9·35	9·45	12·0	12·15	0·84	2	1½	12·30	0·89	3-13½	1	...
0·21	10·15	10·30	12·0	12·25	0·75	2	1½	12·45	0·79	4-8½	1·5	...
0·22	10·25	10·40	12·5	12·30	0·78	3	2	12·50	0·8	4-7	2·0	0·1
0·2	10·0	10·5	12·5	12·15	0·71	3	2	12·35	0·75	4-15½	2·5	0·2
0·2	10·0	10 5	12·0	12·10	0·71	3	2	12·20	0·76	5-3	3·0	0·2
0·19	10·55	11·10	12·45	12·55	0·72	3	2	1·15	0·79	5-9	3·5	0·2
0·2	10·0	10·5	12·0	12·10	0·73	3	2	12·30	0·76	5-12	4·0	0·3
0·2	9·35	10·0	11·10	11·10	0·78	3	2	11·25	0·83	5-14	4·5	0·4
0·2	9·48	10·20	11·35	11·40	0·75	3	2	11·50	0·83	6-3	5·0	0·3
0·16	11·10	11·15	12·30	12·35	0·71	3	2½	12·40	0·8	6-6½	5·5	0·4
0·17	10·10	10·15	11·30	11·35	0·70	3	2½	11·45	0·81	6-14	6·0	0·4
0·18	10·30	10·5	12·5	12·10	0·73	3	2½	12·25	0·79	7-2	6·5	0·5

Table II

Showing the quality of each cheese

Fat per cent in milk	Flavour	Texture	Taste	Body
S. M.	Acidic	Hard and crumbly	Acidic	Very hard
1	Do.	Do.	Do.	Do.
1·5	Do.	Do.	Do.	Do.
2·0	Do.	Do.	Insipid	Hard
2·5	Acidic and pungent	Do.	Pungent, biting	Do.
3·0	Do.	Do.	Do.	Do.
3·5	Milder, acidic than above, not pungent, pleasant.	Not very crumbly	Good	Fairly firm
4·0	Bit acidic, but pleasant and good.	Good	Sharp and bit acidic, but good.	Good and firm
4·5	Mild and very pleasant flavour.	Do.	Very good	Good and better
5·0	More pronounced on acidic side.	Do.	More pronounced on acidic side but good.	Better than previous ones
5·5	Good but not nutty	Quite good rather soft	Inclined to be bit sharp	Good but greasy
6·0	Milder than above but pleasant.	Greasy	Pleasant but bit sharp	Soft
6·5	Nutty, pleasant but very mild.	Of a light quality and mellow but very greasy.	Pleasant and not sharp	More soft.

Table III

Showing net profit obtained for each cheese

Quantity of milk	Percentage of fat in milk	Quantity of ripened cheese obtained		Total cost*			Total realisation by selling†			Net profit			Remarks
		lbs.	ozs.	Rs.	A.	P.	Rs.	A.	P.	Rs.	A.	P.	
50	S. M.	2	6	0	12	9	2	15	6	2	2	9	*For detailed cost of production, see Table V.
50	1·0	2	14	1	1	8	3	9	6	2	7	10	
50	1·5	3	6	1	6	8	3	13	6	2	6	10	
50	2·0	3	8	1	15	4	4	6	0	2	6	8	†Selling price Rs. 1-4-0 a lb.
50	2·5	3	12	2	3	7	4	11	0	2	7	5	
50	3·0	3	15	2	11	11	4	14	9	2	2	10	
50	3·5	4	1	3	0	1	5	1	3	2	1	2	
50	4·0	4	4	3	4	9	5	5	0	2	0	3	
50	4·5	4	9	3	13	2	5	11	3	1	14	1	
50	5·0	4	12	4	5	6	5	15	0	1	9	6	
50	5·5	4	15	4	9	8	6	2	9	1	9	1	
50	6·0	5	2	5	2	0	6	6	6	1	4	6	
50	6·5	5	4	5	10	4	6	9	0	0	14	8	

TABLE IV

Showing total fat lost in each cheese

Quantity of milk in lbs.	Percentage of fat in milk	Total fat in milk	Total fat retained in ripened cheese	Total loss	Percentage of fat lost
		lbs. ozs.	lbs. ozs.	lbs. ozs.	
50 . . .	S. M.	*Nil*	*Nil*	..	..
50 . . .	1·0	0 8	0 8	*Nil*	..
50 . . .	1·5	0 12	0 12	*Nil*	..
50 . . .	2·0	1 0	..	..	..
50 . . .	2·5	1 4	1 2	0 2	10
50 . . .	3·0	1 8	1 5	0 3	12·5
50 . . .	3·5	1 12	1 7	0 5	17·8
50 . . .	4·0	2 0	1 12	0 3·5	10·9
50 . . .	4·5	2 4	2 0·5	0 3·5	9·7
50 . . .	5·0	2 8	2 0	0 8	20·0
50 . . .	5·5	2 12	2 5	0 7	16·0
50 . . .	6·0	3 0	2 7	0 9	18·7
50 . . .	6·5	3 4	2 9	0 11	18·3

TABLE V

Showing detailed cost of production of each cheese

Items	S. M.	1·0 per cent	1·5 per cent	2·0 per cent	2·5 per cent	3·0 per cent	3·5 per cent	4·0 per cent	4·5 per cent	5·0 per cent	5·5 per cent	6·0 per cent	6·5 per cent
	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.
Cost of 50 lbs. of milk	0 8 4	0 12 6	1 0 8	1 9 0	1 13 2	2 5 6	2 9 8	2 13 10	3 6 2	3 14 6	4 2 8	4 11 0	5 3 4
Establishment charges.	0 0 7	0 0 9	0 1 0	0 1 0	0 1 0	0 1 0	0 1 0	0 1 0	0 1 0	0 1 0	0 1 0	0 1 0	0 1 0
Cost of rennet	0 1 6	0 1 8	0 1 8	0 1 8	0 1 8	8 1 8	0 1 8	0 1 8	0 1 8	0 1 8	0 1 8	0 1 8	0 1 8
Cost of cheese colour	0 0 2	0 0 2	0 0 2	0 0 2	0 0 2	0 0 2	0 0 2	0 0 2	0 0 2	0 0 2	0 0 2	0 0 2	0 0 2
Cost of cheese salt, soda, etc.	0 0 2	0 0 3	0 0 3	0 0 3	0 0 3	0 0 3	0 0 3	0 0 4	0 0 4	0 0 4	0 0 4	0 0 4	0 0 4
Cost of cheese cloth, etc.	0 0 2	0 0 3	0 0 4	0 0 5	0 0 5	0 0 5	0 0 5	0 0 6	0 0 6	0 0 6	0 0 6	0 0 6	0 0 6
Depreciation on appliances.	0 0 6	0 0 8	0 1 1	0 1 2	0 1 2	0 1 2	0 1 2	0 1 3	0 1 3	0 1 3	0 1 3	0 1 3	0 1 3
Cost of water, etc.	0 0 8	0 0 8	0 0 9	0 0 9	0 0 9	0 0 9	0 0 9	0 1 0	0 1 0	0 1 0	0 1 0	0 1 0	0 1 0
Ripening charges	0 0 4	0 0 4	0 0 4	0 0 5	0 0 6	0 0 6	0 0 6	0 0 6	0 0 6	0 0 6	0 0 6	0 0 6	0 0 6
Cost of starter	0 0 4	0 0 5	0 0 5	0 0 6	0 0 6	0 0 6	0 0 6	0 0 6	0 0 7	0 0 7	0 0 7	0 0 7	0 0 7
Total cost	0 12 9	1 1 8	1 6 8	1 15 4	2 3 7	2 11 11	3 0 1	3 4 9	3 13 2	4 5 6	4 9 8	5 2 0	5 10 4
*Price at which one pound of milk of different percentage of fat is charged	0 0 3 @ 1¼ lbs.	0 0 3 a lb.	0 0 4 a b.	0 0 6 a lb.	0 0 7 a lb.	0 0 9 a lb.	0 0 10 a lb.	0 0 11 a lb.	0 1 1 a lb.	0 1 3 a lb.	0 1 4 a lb.	0 1 6 a lb.	0 1 8 a lb.

*Prices are charged at bulk rates.

THE STEM-BORER PEST OF RICE (*SCHOENOBIUS INCERTELLUS* W.) IN S. INDIA*

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Introduction

The paddy stem-borer is a well-known insect and has a wide distribution throughout the tropical parts of South-East Asia, and problems connected with this insect have been engaging the attention of scientific workers for many years. In this paper an attempt is made to review briefly the work done so far and to add a summary of the results of the recent investigations made by the authors on the bionomics of this insect in S. India. Though some special studies have been made in Formosa and a very interesting monograph has been issued by Prof. Shiraki as early as 1917 [Shiraki, 1917], there has, so far, been no connected account of the studies on this insect in S. India.

II. History and early records of the pest in S. India

Since the year 1907, when one of the authors (T. V. R.) was deputed to investigate two outbreaks of the pest, one in the Anantapur District early in the year, and another from the Kistna District late in the year, this insect and its injury to the rice crop have been observed more or less continuously in the different rice areas of the Madras Presidency. The pest was fairly common at that time and has continued to be so, the attack varying in different years from slight to severe. The first published record of this insect as affecting rice in India was made in 1909 by Lefroy [1909]. Since then we have references to this insect in Indian publications by Fletcher [1913], Ramakrishna Ayyar [1921], Ghosh [1921], and Ballard [1923]; and from 1922 some intensive work has been done in connection with this insect to supplement the earlier studies. References to the same have appeared now and then in sundry papers and in the administration reports of the Madras Government Entomologist, and those of the Superintendent of the Government Paddy Stations in Aduturai, Maruteru and Pattambi. The latest references to

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*Paper read at the Indian Science Congress, Indore, 1936.

this insect from S. India are to be found in the two publications issued in 1932 and 1933 by the senior author [Ramakrishna Ayyar, 1932, 1933].

III. The systematic position, nomenclature and distribution of the pest

The paddy stem-borer caterpillar is an insect belonging to the order Lepidoptera and is the larva of a Pyralid moth. The first systematic record of this insect under the name *Schoenobius bipunctifer* is by Moore [1886] who described the female moth from Ceylon in 1886. The nomenclature of this insect has unfortunately undergone numerous modifications since then, as may be seen from Fletcher's [1923] note which gives the references to the various names under which records have been made of this insect. One important feature which contributed to this confusion was the striking differences in the external appearance of the two sexes, and this has caused some authors to describe the two sexes under different names. It was not until breeding experiments had been carried out that these forms were recognised as both being *Schoenobius incertellus* W. Two other insects *Sesamia inferens* D. and *Diatroea venosata* W. have occasionally been recorded in small numbers on paddy in the Godavari and Coimbatore Districts, but not in such numbers as to rank in the class of pests. Two other species of *Schoenobius* have been noted in S. India, but these have not so far appeared in numbers. Of these one is *S. immeritalis* Wlk. noted by Hampson [1896] as having been reared on rice in Travancore, but which the authors had not seen, and the other *S. dodatellus* is a species with reddish-brown upper wings once collected in Samalkota in the Godavari District.

S. incertellus is widely distributed and has been noted as a pest of some importance throughout the tropical regions in Asia. It has been recorded from Burma, Ceylon, the Straits Settlements, Malaya Islands, the Philippines and Formosa. In India it is found in Bombay and Bengal as well as in S. India. In the Madras Presidency it is present in almost all rice areas, especially in the Northern Circars, Tanjore and Malabar.

IV. Life-history and bionomics of the insect

In general appearance the borer moth is similar to other Crambinine moths having a medium-sized elongated body with slender limbs and conspicuous prominent palpi like a beak. The female moth is easily distinguished by its yellowish straw-coloured wings and characteristic small black spots on each forewing. The male is smaller in size, more slender in build, brownish-yellow in colour and often without the spots. The life-history of the insect as detailed below is similar to that of many Pyralid borers.

Life history.—The adult female lays its eggs on the tender paddy leaf, often towards the tips, in compact masses, each small mass containing 60 to 100 eggs covered with a tuft of buff-coloured hairs The hatching takes place in five to six days and the young larva after scarifying the green leaves gradually moves on to the plant stem, enters it by biting a hole and spends the larval life inside the

stem. The full-grown larva is elongated and more or less cylindrical and measures about 18 to 24 mm. with the head slightly smaller in size than some of the body segments. The head is brown, and the body has the pale greenish or whitish colour usually characteristic of borers. The body is soft and the small hairs are more conspicuous on the head and near the anal region. The five pairs of pro-legs are slender and short, with hooks arranged in a circle. The spiracles on each side are seen as minute dark brown spots. In the course of four to five weeks the larva pupates within a silken water-tight cocoon inside the stem usually towards its lower portions and finally emerges as the adult moth in about ten days. It appears possible that three broods may be completed in course of one crop under field conditions, though only the second and third brood stages have been more closely followed.

Alternate food plants.—Continuous investigations to discover other host plants, if any, on which this insect may breed have not proved successful for it appears the moth breeds only on paddy right through the year. Statements have been made by Fletcher [1917] that the grasses *Ischoemum striatum, Andropogon Odoratus* and *Anthistiria ciliata,* have been found to be the natural food plants of the insect in the Bombay Presidency. But this has not been confirmed by any later work, and the writers have very great hesitation in accepting such records as reliable since the moth has not been found breeding on any of the numerous grasses found growing in S. India till now, nor have experiments to rear the moths on grasses been successful.

Natural enemies.—As regards natural enemies of the pest, frequent rearings of the insect in different areas during different seasons have revealed the presence of a few Hymenopterous parasites associated with the egg and the larval stages of the pest. The following insects have been bred out [Ramakrishna Ayyar and Margabandhu, 1934] as parasites :

(*a*) on the caterpillar :—

1. *Ichnojoppa luteolator* F. (Ichneumonid) in Godavari and Coimbatore.
2. *Goryphus maculipennes* C. (Ichneumonid) Samalkota, Godavari District.
3. *Tropobracon indicus*, Ram (Braconid) Coimbatore, Godavari, S. Canara, Ceded Districts and Mysore.
4. *Apanteles schoenobii* W. (Braconid) Mysore and Ceded Districts.

(*b*) on eggs :—

1. *Tetrastichus schoenobii* F. (Chalcid) Mysore and Coimbatore.
2. *Trichogramma minutum* R. (Chetid) Mysore and Coimbatore.
3. *Phanurus beneficiens* Z. (Scelionid) Mysore.

Behaviour of the insect.—Among the more important habits of the insect is the intensive positive phototropism displayed by the female moth [**Ramakrishna Ayyar, 1921 ; Ramakrishna Ayyar and Anantanarayanan, 1934**].

V. Nature and extent of damage caused by the pest

The external indication of damage in the nursery and in a young crop is the presence of deadhearts or wilting of the central shoots, whereas in a crop with ears, the presence of white ears marks the infestation. Due to this the disease is known in the vernaculars as *Thella Kanki*, *Oosa theru*, *Venkani*, *Savi*, etc. As a rule the attack is severer in double-cropped areas than in single-crop tracts. The percentage of infestation varies in different localities, the heaviest damage being in a rainfed second crop, in districts of heavy rainfall. Recent observations on the extent of damage in the typical centres of the Godavari Delta, Coimbatore and Malabar, have shown that the percentage of infested plants varies from 3 to 65 per cent, reference being made to white ears only. The actual estimate of the extent of loss or degree of damage is rendered very difficult, due to great variations in the nature of the soils, the varieties of crop raised, the periods of cultivation, the duration of the different varieties, the climatic conditions of the seasons and other factors. In the early stages of the growth of paddy the transplanted second crop often suffers very badly and not infrequently by a peculiar combination of insect abundance, suitable stage of the crop, and favourable weather, the plants are almost totally destroyed thereby making re-sowing necessary. This borer has been noted to be the root cause of much extensive damage to the newly transplanted second crop in Palghat in 1932, in Pattambi in 1933, and in Coimbatore in 1934. Ordinarily in a vigorously growing field the attack in early stages, though causing deadhearts, is made good by the formation of fresh tillers so that there is ultimately little difference between an attacked and an unattacked plant. Attack during the later stages of vegetative growth tends to produce tillers of uneven growth, sometimes interfering with uniformity in flowering. The worst effects are from attack during the flowering stage of the crop when the 'white ears' are seen in numbers, resulting in irreparable loss to the ryot. It is possible that in some cases 'white ears' are caused by agencies other than borers, but these may be distinguished by the following features :—

1. *Stem-borer attack.* Definite hole or cut, at or above the second node from the top; insect excreta inside the bored stem or the insect itself inside the stem; ear dry.
2. *Rice-bug attack.* In the earhead some of the grains are well-set, and some only are chaff.
3. *Sterility.* The stem lower below the first node from the top is green and fresh with no insect or insect damage.
4. *Pyricularia* (Fungus). Black colour at node and ears.

VI. Factors influencing pest incidence

As regards the varietal and seasonal factors influencing pest infestation, it has been found that there is practically no cultivated variety which is found completely free from borer attack. Nearly a thousand types grown at the paddy-

breeding station at Coimbatore have been examined, besides the various bulk crops growing in the districts, and there have been no indications that any particular variety is borer-free. The percentage of attack on various types is not relatively consistent from year to year. The percentage of infested plants at the ear-head stage in a series of fortnightly plantings at the paddy-breeding station at Coimbatore was found to vary for different months, the maximum damage occurring in August-September plantings which flower in December and January, the least damage being caused to plantings from February through the summer months, when flowering takes place late in July and August irregularly. Parallel observations on a second variety grown at the Agricultural Research Station, Pattambi, also showed similar variations for plantings in monthly series. Under the circumstances, the important factors governing pest incidence appear to be primarily moth abundance, and the climatic conditions of the habitat. In a single-crop area the moths generally appear about a month after planting, and breed in the crop for at least two generations before harvest. The emergence immediately after harvest is the strongest brood, and this in a double-cropped area continues to infest the following crop. When there is lack of uniformity in planting and when there are more crops than one, grown successively in the same tract, there is overlapping of broods, and moths may be in abundance throughout the entire season of the paddy crop after the second brood. This overlapping of crops from season to season evidently helps the pest to carry on through the whole year without the help of any other food plant than paddy. This is also confirmed by the fact that, in parts of Godavari and Malabar, swampy varieties of paddy grown during the off-seasons and occasionally self-sown seeds, harbour the pest in some low-lying areas. Thus at Maruteru the biggest broods have been noted in February and May, at Coimbatore in January-February and at Pattambi during September-October and January-February. Apart from the observations on the stages of the pest and its life-cycle in the field, the light trap catches give additional information regarding the broods. That the micro-climate of the crop has a share in determining the severity of the attack is shown by the following facts also :—

(*i*) The egg-masses appear in a crop of suitable stage immediately after irrigation, or the moths prefer crops with standing water to a crop without water. (*ii*) In the same locality a crop of the same age is more easily attacked in low-lying ill-drained plots than in high level fields. (*iii*) Thicker dry-sown broadcast paddy shows less attack than transplanted paddy. (*iv*) When the water in an attacked field dries up the larvæ seek stems growing under moister conditions. The influence exerted by seasonal factors of the locality are also of significance in that (*a*) the largest number of egg-masses and moths are noted in rainy months or immediately after ; (*b*) the earliest crops immediately after summer, as well as the third crop in certain localities raised during the hottest part of the year generally escape infestation, though moths may be evident during the course of the crop in sufficient numbers. In general, the moths appear for every crop in smaller or larger

numbers, but the severity of attack and successful breeding would appear to depend upon the climatic conditions and the condition of the crop obtaining in the localities. Both from observations in the field, and from rearing experiences in the laboratory, indications are not wanting to show that the insect requires a high degree of humidity for its normal breeding. Some of these preliminary observations on the influence of climate on pest incidence have already been recorded in a paper by the authors [Ramakrishna Ayyar and Anantanarayanan, 1935].

VII. The problem of control

The problem of combating this pest has been always difficult. Various means have been tried by workers in the past both in India and outside. Insecticidal methods are evidently out of question in such a case since the borers are safe inside the stems and beyond the reach of any toxic materials. The control measures against this pest have therefore to be prophylactic, chiefly cultural and mechanical. Of course there is also the possibility of biological control.

The preventive measures that might be adopted with advantage in connection with this borer consist of (*a*) collection of egg-masses, (*b*) elimination of infested seedlings before transplanting, (*c*) destruction of deadhearted shoots, (*d*) destruction of stubble and (*e*) the use of light traps. Each of these methods may or may not be feasible in all tracts and under all conditions, but if one or more of the possible methods are tried in an infested locality by all farmers in co-operation there will be appreciable benefit and the pest can gradually be brought under perceptible control. Unfortunately what with the indifference of our farmers, the absolute want of co-operation in such matters among them and, above all, their peculiar attitude towards such pests as divine curses, we find that such preventive measures are often difficult or impracticable. In the collecting of egg-masses the operations have to be carried on for over a month from planting and again a few days before the flowering of the crop without a correct knowledge of the period for concentrated action. In parts of Malabar and Coimbatore, the nurseries show practically no egg-mass, even at the height of the emergence of broods, whereas at Maruteru and in parts of the Godavary Delta plenty of egg-masses have been recorded from nurseries due probably to the varying cultural practices in the localities and to the season. As already stated infestation in the early stages, may not have serious consequences, the borer damage acting only as a sort of pruning to give rise to profuse fresh tillering in a fertile soil. Moreover, the location and the mechanical collection of eggmasses after the shot-blade stage in a field are not easy and safe methods, and at the same time we run the risk of damage to the crop by trampling. Even with regard to the collection and destruction of deadhearts, the advantage gained is not commensurate with the time and labour involved. For, a larva attacks more than one stem and often by pulling out the deadhearts from the top the free end of the plant comes away leaving behind the larva if any, in the plant itself. For effective removal of the larva,

the whole stem has to be severed from the clump with the root portion. In practical experience only a very small percentage of the uprooted deadhearts contain the actual borer. The comparative futility of the operation is made obvious, when it is seen that in the shooting stage of the crop, the larva is found also in apparently healthy stems showing absolutely no outward signs of infestation because of the habit of the larvæ moving from stem to stem. In certain plots at least, healthy stems may be as much infected as deadhearts or even more so. As regards the destruction of the insect population in the stubble after harvest, ploughing with flooding wherever possible appears to be a very effective method and by actual counts it is seen that a very large number of larvæ remain in the stems immediately after harvest. But in many cases, except when a crop is raised in the same locality immediately after harvest, the plots are dry without facilities for further irrigation. It has also been noted by actual counts of stem borer population in the stubble after harvest during the off-season that in parts of Coimbatore and Pattambi there was no live specimen of the insects in the stubble two months after harvest in any stage, so that it would appear that no stage of the insect of one crop passes over in a quiescent stage to the succeeding crop in the same locality. So far in S. India there is no record of larvæ aestivating through the off-season.

Use of light traps.—As has been repeatedly stated in the authors' papers and by other workers in and outside India there is no doubt that light has a very strong attraction for the female moth of this pest. There has however been some difference of opinion as to the efficacy of this method. Fletcher [1917] and Ballard [1923] do not think that this method is of much value. It is however very surprising to find that in his paper the latter has not expressed this opinion in spite of the fact that the results of his experiments clearly show that there was a higher catch of gravid moths than spent ones. To test the efficacy of light traps, trials were started by the writers in 1931 and continued for over two years. The following remarks made by the writers in their paper of last year [Ramakrishna Ayyar and Anantanarayanan, 1934] might be found pertinent in this connection. "Recent observations on the light trap catches have made it abundantly clear that the paddy stem-borer is by far the most easily attracted and the most numerous of the forms captured. The catches of moths of this borer during the different parts of the year at Coimbatore, Pattambi, Maruteru and Aduturai were as follows :—

Coimbatore .	Total 4013 (3362 Female ; 651 Male) in 83 nights, December 1932 to March 1933.
Pattambi .	5342 (2796 Female gravid ; 369 Male ; 2176 Female spent) in 29 nights, June 1933 to August 1933.
Maruteru .	15427 (9090 Female gravid ; 5038 Male ; 1299 Female spent) in 106 nights, September 1932 to February 7th, 1933.
Aduturai .	5090 in 15 days—November 1932 to February 1933. Maximum 879 on 6th January 1933.

From the preliminary observations so far made it has been found that (1) at every fresh brood the insect comes to light in very large numbers ; (2) at the peak of emergence it is highly phototropic and comes to light at all hours of the night even on moon-light nights ; (3) the percentage of gravid females to males varies in different localities and at the same locality during the season and (5) during the paddy season the insect makes its first appearance in the trap during transplantation." As a result of the conclusions arrived at so far, the authors feel that the light trap is one of the best methods of control against this pest and may safely state that (1) a 200-candle power Petromax light would serve to trap a large number of moths within a radius of 1½ furlongs from the light and leave a sufficient impression on the crop by reduction in infestation ; (2) the light trap will be most useful in reducing infestation in the fields immediately after planting and also immediately after the shot-blade stage of the crop and (3) the time of setting of the trap has to be determined for each place with reference to the age of the crop and the number of broods obtaining in the locality.

VIII. Some useful local practices

(*i*) In parts like Malabar the practice of clipping tips of seedlings, bundling them up with all shoots in the centre and exposing all the roots, and delaying the planting for two days, serve to eliminate a large percentage of the eggmasses if any, as also the contained larvæ, which either perish inside or leave the plants and perish. (*ii*) Bonfires in fields of dry weeds, stubble and grasses shortly after sowing operations are over, as is being done in the Kole area of the Malabar coast, serve to destroy a large number of moths and other insects which are positively phototropic. (*iii*) The village festival of 'Karthigaideepam' when illumination is done on a large scale serves at least to distract the moths from the fields to distant places where; hey perish, as this happens during November-December, when moths are in plenty.

Coming to the biological methods that may be adopted against this pest, though some parasites exist and the bionomics of a few have been studied to some extent. a good deal of work has to be done in connection with the distribution, life-history, host preferences, inter-relations and finally their comparative effectiveness as natural enemies before anything practical can be attempted on an economic scale. It may be interesting to note that one of the parasites is the well-known egg-parasite *Trichogramma minutum* R. which is playing an important role in the control of sugarcane borers all over the world.

IX. Conclusions

While the writers feel that it has been possible to add to our knowledge of this pest to a certain extent, they believe that a good deal of further work can be done on the lines mentioned above. The study of the response of the insect to changing weather conditions, is of paramount importance with a view to note (1) the circumstances under which a crop can tolerate the pest and (2) the cultural practices which may help the plants to withstand attack.

The writers have to thank the Madras Government Paddy Specialist and his staff in the different paddy stations in the province for the help they have received in connection with their investigations of this important pest of rice.

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SOME ASPECTS OF POULTRY BREEDING AT THE LIVE-STOCK RESEARCH STATION, HOSUR

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Poultry has been bred on this Farm for over ten years. Most of the work has been with imported breeds, Leghorns, Light Sussex and Rhode Island Reds, but since 1931 Chittagongs and an indigenous variety with black feather, flesh and bone have been bred. The latter variety has been called the "Tellicherry breed" because the foundation stock was purchased at Tellicherry in the West Coast. The Black Minorcas were introduced in 1932. All the birds are kept in runs suitably housed and rationed and great care and attention are bestowed on them from the time of hatching. There is a veterinary hospital on the station. If any disease is suspected veterinary aid is given immediately. Every precaution is taken with regard to infectious diseases. Periodic liming of runs, thorough cleaning of houses daily, potassium permanganate or treacle in drinking water are the main features. It would be interesting to see how various breeds behave under the prevailing conditions.

Periodicity.—It is well known that seasons affect the sexual activity of animals. In the case of hens, that length of day light which can be regulated artificially can affect egg yield is also well known. All the European birds on this Farm are born to birds imported from England which have noteworthy pedigree trapnesting records. Nevertheless, both the imported birds and those born to them have to live in an environment, including weather conditions, very much different to those in England. Even in the case of Chittagong and the Tellicherry breeds their original environments are different to those prevailing at Hosur.

On this Farm, the hatching is under the management of a woman maistry who gives individual attention to all birds hatched. All the birds are fed in accordance with the rations given in Table I (feeding routine) with modifications depending on individuality.

Table I

Feeding routine

Age	Feed	Drink
Chicks up to 36 hours	No feed	Keep them in warm brooder up to 95°F.
Up to 5 days. . .	Ground oats on feeding troughs sparingly 5 times a a day at an interval of 2½ hrs. each, 5 oz. oat per day for 30 chicks.	Skimmed milk 8 oz. a day.
5 to 15 days . .	Grain feed as noted above, boiled eggs mixed with egg shell fed at 11 A.M. 2 eggs for 30 chicks.	Do. Do.
15 days to 1 month .	Broken wheat 1 lb., grated boiled eggs 7. Wheat-bran 1 lb. mixed with water. Feed 4 times a day for 70 chicks.	Skimmed milk 1½ lb., vegetable leaves such as lettuce, cabbage and cauliflower also lucerne.
1 to 2 months . .	2 lb. broken wheat 6-30 A.M. 6 lb. wheat bran, ½ lb. groundnut cake, 1½ lb. cooked beef for 100 chicks — Mixed & fed at 1-30 P.M.	Skimmed milk, Butter milk, Whole milk — 3½ oz. Treacle diluted in water, potassium permanganate in water.
2 to 3 months . .	2 lb. boiled rice at 4 P.M. Paddy and *cholam* 2 lb. at 6-30. Wheat-bran 6 lb., Mash 2 lb. — at 1-30 P.M. for 80 chicks. On an average each bird gets ½ oz. mash and wheat-bran 1 oz.	*Stock mash.* Wheat-bran . . 30 lb. Rice-bran . . 20 lb. Ragi . . . 30 lb. G. N. Cake . 10 lb. Mineral mix. . 3 lb. Salt . . . 1 lb. Skim milk, whole milk and butter milk . . 2 lb.
3 to 6 months . .	Paddy & *cholam* 3 lb., Stock mash 8 lb. — for 80 birds.	Shell grit and charcoal should be available before them always, cooked rice and beef on alternate days.
After 6 months . .	Paddy & *cholam* 5 lb., Wheat 5 lb., Stock mash 12 lb. — for 135 birds.	Do. Do.

On an average each adult bird gets 1 oz. grain and 2 oz. mash and ½ oz. of cooked rice,

Whetham [1933] has made an interesting study with regard to factors modifying egg-production in different parts of the world. As our birds are from England, it would be interesting to compare the figures for egg-production for latitude 55°N. and that of 10°N. While comparing the figures for the tropics, it must be borne in mind that Philippines, Trinidad and the Gold Coast have the sea very near and Hosur is just over 3,000 ft. above sea-level and away from the sea. It will be seen from the tables attached that variation in day light in the tropics is not as marked as that of latitude 55°N. While egg yields are higher in the higher latitude there is tendency for egg yield to be low in October-November and gradual increase from then to May. It is however interesting to note that the Irish results are not so good and the yield is lower than here, but it must be borne in mind that the Irish results are for general stock in 1911-12 and the Hosur results are for a small number of select birds. Moreover, the Irish laying tests at present compare favourably with those of England and Scotland. In the tropics, Hosur figures both for indigenous and imported breeds excepting for the Cantonese are the best. Comparing the yield of eggs produced by imported stock with those produced in the higher latitude it is apparent that latitude including environmental conditions in the Tropics do not tend to give as good results as those in the higher latitude. Taking the Indian indigenous breeds, the total yields indicate that they are better than other breeds outside India excepting the Cantonese in the Tropics and that they are not markedly inferior to the yields of imported breeds. The annual yield of 137 for the Chittagongs is particularly noteworthy and it shows what can be achieved with the indigenous fowls. Viewing production figures in general it is seen that monthly rate of production tends to be about the same for identical latitudes but that the total production is considerably affected by altitude and other environmental conditions.

TABLE II

Latitude 55° N

Place	Year	Remarks	Age	Breed	No.	Jan.	Feb.	Mar.	April	May	June	July	Augt.	Sep.	Oct.	Nov.	Dec.	Total
	Hours of day light					7 38	9·32	11·40	**14·04**	16·10	17·28	16·56	15·06	12·42	10·28	8·14	6·54	
	Eggs per bird per month																	
1. Denmark.	1915-21	Egglaying tests.	1	Br. L B.P.R.	120	6·6	9·1	18·1	**19·7**	19 5	17·8	16·9	15·4	**12·0**	(5·0)	(0·6)	2·5	143·2
2. Do.	1927-30	„	1	„	50	9·0	9·6	17·5	**20·4**	20 9	19·1	19 2	17·0	**12·2**	6·3	2·8	6·7	160·7
3. Ireland	1911-12	General results.	"Hens"	Mixed	5500	6·3	9·3	15·9	**15·8**	14·9	11·5	10·1	8·3	**6·0**	3·9	2·4	4·0	108·4
4. Scotland	1930-31	Egglaying tests.	1	„	350	15·1	15·9	21·3	**22·1**	21·9	18·5	17·0	17·0	(15·3)	(11·9)	11·4	14·6	202·0
5. England	1924-29	„	1	„	9079	17·4	16·0	21·0	21·0	19·7	16·9	15·8	14·0	**12·3**	11·2	11·7	14·0	191·0
	Average		...	...	15099	13·2	13·5	19·1	19·1	18·0	15·0	13·8	12·0	10·1	8·5	8·2	10·2	160·7 (161·7)
	Percentage		...	...	...	8·2	9·0	11·8	11·8	11·1	9·3	8·5	7·4	**6·2**	5·3	5·1	**6·3**	

Adapted from "Factors Modifying Egg Production with Special Reference to Seasonal Changes" by Elizabeth O. Whetham.

TABLE III

Latitude 10° N

Place	Year	Remarks	Age	Breed	No.	Jan.	Feb	Mar.	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
	Hours of day light					11·25	11·44	12·00	12·21	12·35	12·45	12·42	12·27	12·09	11·50	11·33	11·22	
						Eggs per bird per month												
1. Philippines	1928	Agr. Coll. Flock.	...	Cant-onese.	20	20·1	20·1	11·2	14·7	11·3	16·0	13·5	17·3	15·1	8·4	6·5	15·8	170·0
2. ,,	1922-27	,,	...	,,	20-40	9·1	9·6	10·2	9·4	8	8·1	7·7	6·0	7·2	6·6	6·4	6·1	95·2
3. ,,	,,	,,	...	Native	15-18	7·3	8·6	10·9	9·8	10·0	9·5	8·7	7·1	6·5	6·8	5·7	5·9	96·8
4. ,,	,,	,,	...	W. L.	15-18	9·7	9·5	11·1	10·0	10·1	10·3	9·6	9·5	4·8	6·4	8·9	6·3	106·2
5. ,,	,,	,,	...	R. I. R	15-18	5·4	7·0	8·7	8·5	8·9	8·3	9·2	7·8	4·9	4·2	5·3	3·9	82·1
6. ,,	,,	,,	...	B. P. R	15-18	6·0	9·2	10·9	10·0	10·2	8·3	8·5	6·1	4·7	5·7	6·5	4·3	90·4
7. Trinidad	1928-29	Govt. Stock Farms.	...	Mixed	110-181	9·6	7·4	6·4	5·6	8·1	6·7	5·4	2·9	1·7	0·9	1·2	6·9	62·8
8. Gold Coast	1931-32	Expt. Farm Flock.	...	Mixed	90	9·3	7·2	7·9	8·4	9·1	8·1	5·0	3·2	2·2	3·6	1·8	5·9	71·7
9. S. India H. C. F.	1931	Govt. Stock Farm.	1 & 2	W L	8-24	12·5	10·1	10·3	14·6	10·2	10·7	12·3	12·3	15·0	9·7	12·6	12·7	143·0
10. ,,	,,	,,	,,	R I R	5-17	10·5	10·5	10·1	16·2	11·3	10·6	14·0	8·5	10·5	11·6	12·8	9·2	135·8
11. ,,	,,	,,	,,	L. S.	6-19	11·0	10·8	9·6	9·3	9·2	9·3	11·1	9·8	8·8	9·8	12·3	10·5	121·5
12. ,,	1934-35	,,	...	W. L	12-25	11·7	11·7	12·9	11·2	12·2	12·1	10·4	12·4	8·9	12·2	11·5	15·0	142·2
13. ,,	,,	,,	...	R.I.R.	24-30	14·8	11·1	14·9	10·8	14·2	14·3	13·0	12·8	12·0	12·0	13·5	14·0	157·4
14. ,,	,,	,,	...	L. S.	18-23	10·5	9·4	10·0	12·4	10·6	11·5	8·2	11·5	9·4	10·0	9·6	10·3	123·4
15. ,,	,,	,,	...	B. M.	12-18	13·9	12·8	11·7	14·6	14·5	12·2	10·6	9·9	11·0	10·7	11·7	13·0	146·6
16. ,,	,,	,,	...	Chitta-gong.	8-15	12·3	13·5	11·7	9·6	10·8	10·8	13·3	11·6	9·7	10·7	9·1	14·1	137·2
17. ,,	,,	,,	...	Telli-cherry.	9-18	6·5	10·7	6·5	9·1	9·7	11·3	7·5	8·4	8·9	9·4	9·3	9·3	106·6
		Average				10·7	10·3	9·8	7·4	10·5	10·2	8·9	8·3	7·3	7·5	7·4	9·9	112·3

1 to 8—Adapted from "Factors Modifying Egg Production with Special Reference to Seasonal Changes" by Elizabeth O. Whetham.

Size of eggs.—In addition to the number of eggs laid, the size or weight of eggs is of importance. At Hosur, all eggs are collected from the trapnest and graded. There are four grades, A, B, C and D. "A" grade eggs weigh about 2 oz. each, "B" between 1 3/4 and 2 oz., "C" 1 1/2 to 1 3/4 oz. and "D" below 1 1/2 oz. The grading of eggs was done irrespective of the age of birds. The tables below give the various grades for each breed.

Breed	No. of hens	No. of hens that laid eggs of :—				Percentage of hens that laid eggs of :—			
		A	B	C	D	A	B	C	D
Light Sussex	26	17	25	12	7	65·4	96·2	46·2	26·9
Black Minorca	19	7	19	10	5	36·8	100·0	52·6	26·3
White Leghorn	28	6	28	19	4	21·4	100·0	67·9	14·3
Rhode Island Red	30	5	30	20	14	16·6	100·0	66·6	46·6
Chittagong	12	1	7	12	12	8·3	58·3	100·0	100·0
Tellicherry	16	..	7	14	15	..	43·8	87·5	93·8

Breed	Total No. of eggs	Classification of eggs into grades				Percentage of graded eggs			
		A	B	C	D	A	B	C	D
Light Sussex	980	298	603	64	15	30·4	61·5	6·5	1·5
Black Minorca	736	53	606	72	8	7·2	82·3	9·8	1·1
White Leghorn	1512	101	1221	170	20	6·7	80·8	11·2	1·3
Rhode Island Red	1167	57	861	203	46	4·9	73·8	17·4	4·1
Chittagong	487	1	35	154	297	0·2	7·2	31·6	61·0
Tellicherry	498	..	72	229	197	..	14·4	46·0	39·6

To begin with it must be noted that the results are not from a large number of birds, but this is a limitation that could not be overcome. It will be seen that Light Sussex gives the most "A" grade eggs while most of the imported breeds gave a high percentage of "B" grades. Nevertheless, they also laid "C" and "D" grade. The Tellicherry laid no "A" grade but the percentage of "B" and "C" grades are higher than those of the Chittagongs. The results indicate that in time it should be possible to improve the size of the eggs of Indian breeds. If results for imported breeds are compared with those of egg laying trials of England, it would appear that the size of eggs from imported stock has suffered.

Resistance to disease and adaptability.—The indigenous breeds, despite their defects, have been evolved as a result of natural selection, but in the fighting birds man has played an important part. In the latter case, as egg yield is not important and stamina, courage and other fighting qualities are required, the selection by man has been more severe. The indigenous birds seem to adapt themselves to prevailing conditions from the time of hatching. They know their enemies, for instance, chicks will take cover very quickly as soon as a kite or vulture is sighted. Some ryots have told the author that the imported birds are so stupid that they will sleep under a halting bus and will not move out even when the bus starts. This results in a number of deaths.

In addition to natural enemies the heat and the monsoon are problems by themselves. In the last heat wave, a very large number of imported birds died of heatstroke in various parts of the country.

Poultry diseases in the tropics are virulent and the ryot has no effective remedy for the pseudopest, fowl cholera, chicken-pox which take a large toll. Tables IV and V give an idea of the various causes of death noted in the Live-stock Research Station. Though the numbers are small the results do give an idea of how the diseases are distributed and which of the breeds easily succumb to them.

TABLE IV

Deaths in various breeds of poultry at the Live-stock Research Station, Hosur, due to various diseases for 1933-35

Name of disease	White Leghorn	Rhode Island Red	Light Sussex	Black Minorca	Chitta-gong	Telli-cherry
1. (*a*) Virus diseases such as pox, roup and catarrh, etc.	14	13	7	9	4	3
(*b*) Fowl tumours . .	..	..	1	2	..	..
2. Coccidiosis . . .	1	1	1	1	1	..
3. Helmenthiasis (parasitism.)	20	33	16	54	16	18
4. Diseases of digestive system.	3	3	1	5	..	..
5. Diseases due to the diseased condition of the liver.	4	4	5	4	2	3
6. Diseases of the lungs .	1	1	..	..	..	..
7. Pathological condition of the oviduct.	5	3	..	3	..	..
8. Deformities . . .	7	4	..	..	3	..
9. Accidents . . .	..	1	1	..	..	..
10. Reptile bite . . .	1	..	..	1	..	..
Total .	55	63	32	78	26	24

TABLE V

Percentage of deaths in various breeds of poultry at the Live-stock Research Station, Hosur, due to various diseases for 1933-35

Name of disease	White Leghorn	Rhode Island Red	Light Sussex	Black Minorca	Chitta-gong	Telli-cherry
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
1. (*a*) Virus disease such as pox, catarrh, etc.	4·62	2·49	2·17	2·35	4·59	2·05
(*b*) Fowl tumours .	..	..	0·31	0·52	*Nil*	*Nil*
2. Coccidiosis . . .	0·33	0·19	0·31	0·26	1·14	..
3. Helmenthiasis (parasitism)	6·60	6·32	5·27	14·13	18·38	12·32
4. Disease of the digestive system.	0·99	0·57	0·31	2·60	..	..
5. Disease due to diseased condition of the liver	1·32	0·76	1·55	1·04	2·28	2·05
6. Disease of the lungs .	0·33	2·49	..	..	..	..
7. Pathological condition of the oviduct.	1·65	0·57	..	0·78	..	..
8. Deformities . . .	2·31	0·76	..	..	3·43	..
9. Accidents . . .	..	0·19	0·31	..	..	..
10. Reptile bite . . .	0·33	*Nil*	0·31	0·26	..	..

SUMMARY

The performances of various breeds in the tropics and those in latitude 55°N. have been compared.

The value of grading up of eggs for various breeds has been explained.

Capacity for resistance to diseases and adaptability of breeds maintained have been explained.

The results obtained in this Live-stock Research Station indicate that more attention should be paid to the improvement of indigenous breeds.

REFERENCE

Whetham, Elizabeth O. (1933). *Jour. of Agri. Sci.*, Vol. XXIII : part II, July 1933.

H 2

THE NEW SLOTTED POTTERY STRAINER

BY

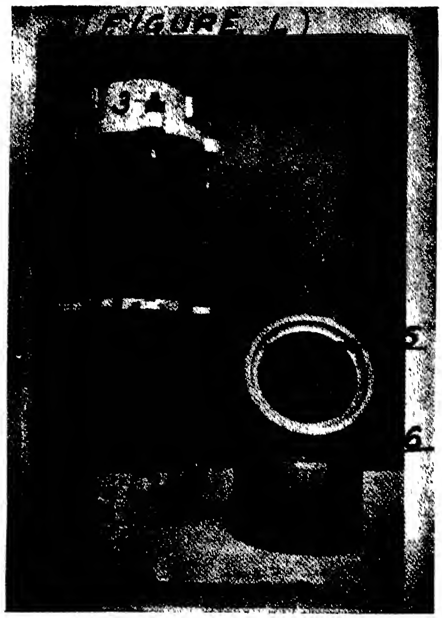
The Agricultural Engineer to Government, Punjab

INTRODUCTION

THE Engineering Section of the Punjab Department of Agriculture has been attempting to evolve an efficient and cheap strainer for wells and tube-wells. Miller Brownlie and Mohammad Abdullah Khan evolved a strainer which consisted of stoneware segmental slips, which could be manufactured by the local potteries, and filled in a skeleton frame, consisting of mild steel bars and sheet iron joints, which could be locally prepared. The cost of this strainer, as charged from the well owners, was Rs. 4-8-0 per ft.

In 1929 a radical change was made in the material employed to make the segmental slips and instead of stoneware bituminous composition was used, and instead of iron joints aluminium joints were introduced. The complete strainer, frame and all was supplied by a pottery at Delhi. Its manufacture by this time was protected by Brownlie-Bhaskar Patent and it cost the Department Rs. 5-8-0 per ft. at Delhi, and was supplied to the well owners, after adding the distribution charges, at Rs. 6 per ft. This price was raised temporarily to cover depreciation of the stock to Rs. 6-3 0 per ft.

This was the strainer which had been used almost exclusively during the last five years by this Department for the augmentation of supply of wells as well as for independent small power-worked tube-wells of the capacities ranging from 6,000 to 8,000 gallons an hour. The type used was 5-in. overall composition strainer. While the price of the strainer had been steadily rising the economic depression among the zamindars had been becoming acute, with the result that the ever-decreasing financial resources of the well owners have now placed even this, the cheapest scientifically-built strainer, outside their purchasing capacity. As a further result cheap, crudely-built strainers have been produced by the village artisans to meet the demands of the rural market. Even burnt clay pipes with needle holes or punched tin-sheet pipes wound over with fibre have been employed. These unreliable strainers are being readily accepted by the zamindars because of their cheapness, although it is generally realised that they cannot last very long, and cannot yield a dependable supply of water.



The new slotted pottery strainer

Essentials of design

The necessity for a cheap, reliable and scientifically-designed strainer was being very keenly felt and with this end in view a strainer has been designed which while retaining the good points of the stoneware and composition strainers, and without infringing any of their patented features, will be within the means of an ordinary well owner. It has been completed and successfully tested. A brief description of it is given below.

Description

Plate X is a photograph of the strainer. It shows a unit of the strainer consisting of (1) 4-slotted pipe element, (2) in mild steel bar frame, intermediate strengthening aluminium rings, (3) aluminium end-joint, and (4) 2-slotted pipe elements which when built one above the other in the frame form the strainer. Strainer element consists of a hard-burnt, perfectly cylindrical pottery pipes, three inches in length. On one end of each piece is a projecting ring (*d.* 5) 1/4th of an inch high and half the thickness of the pipe, and at the other end is a recess (*d.* 6) into which the rim of the lower piece fits ; a continuous strainer is thus formed, the joint between the two pieces does not allow sand to pass through and leaves a smooth continuous outer surface. The water way area is provided by vertical slots cut in the wall of this clay cylinder. The slot is X-shaped and at its narrowest part it can be cut to an evidol varying from 12/1,000 to 5/1,000 of an inch. Strong aluminium coupling joints which are provided at the top and bottom of each three-feet strainer length can be seen in the photograph. Several lengths of strainer can be joined by this means very simply.

Size and capacity

At present these clay cylinder strainers are being made in two sizes : (*i*) 3½-in. internal and 4½-in. external diameter, for discharges from 5,500 to 7,000 gallons an hour, and (*ii*) 6-in. internal and 7-in. external diameter for discharges from 15,000 to 20,000 gallons per hour.

These sizes have been fixed with a view to suit the standard casing pipes of 7-in. and 10-in. size, making due allowance for the usual shrouding. This strainer is 25 per cent lighter than the composition strainer.

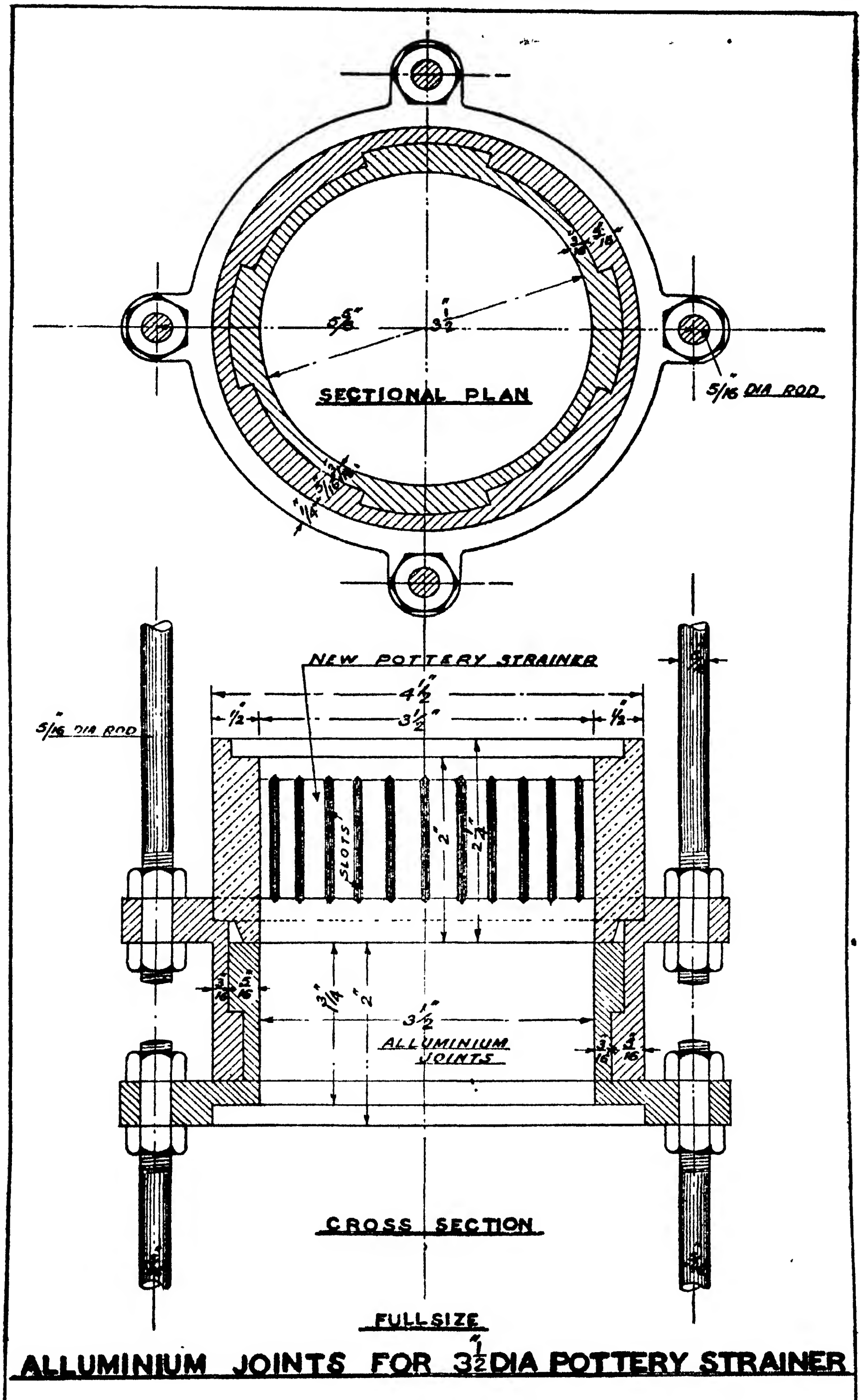


FIG. 1. The new slotted pottery strainer.

Discharge

The following table gives details of a few of these strainers recently sunk in bores and the resulting discharge in each case :—

Village or place of boring	District	Size of strainer	Length of strainer in ft.	Dis-charge gls. per hour	Draw down in ft. & in.	Discharge per sq. ft. of surface per ft. of draw down
Ferozepur . .	Ferozepur .	3½-4½-in.	27	5,400	4–6	31
Ferozepur . .	Ferozepur .	Do.	18	4,300	10	20
Bhangar . .	Lahore .	Do.	18	1,920	3	30
Badiana . .	Jullundur .	Do.	39	5,797	8	16
Mianwal . .	Gujrat .	Do.	15	3,711	3	69
Pandowal Bala .	Gujrat .	Do.	15	3,545	3	65
Chak 13/672 . .	Lyallpur .	Do.	15	2,837	2–3	70
Kurianwala . .	Jhang . .	Do.	12	2,880	2–3	88
Wan Dharm Singh .	Montgomery	Do.	12	2,450	3	56
Winjoil . . .	Montgomery.	Do.	12	2,706	3	62
Khakhar . .	Multan .	Do.	15	2,945	3	54
Sahjra . . .	Lahore .	Do.	18	1,931	3	28
Bir Raja Teja Singh	Amritsar .	Do.	18	1,669	3	25
Khun Khun Khurd	Hoshiarpur .	Do.	18	2,511	4	29
Jartoli . . .	Ludhiana .	Do.	12	2,019	4	35

Price

The cost of production of this strainer (3 1/2-in.-4 1/2-in.) is Rs. 3-4-0 per ft. at Sialkot. Allowing 0-4-0 per ft. as distribution charges, it is being sold to the well-owners at Rs. 3-8-0 per ft.

Large size

The larger strainer (6-in.-7-in.) has also been completed and successfully sunk in a well. It has not been tried so far on a large scale, because owing to the size and weight of the pottery pipe pieces the percentage of breakage during transit in railway is considerable. Experiments in packing are in hand to overcome the distribution difficulties and when these have been removed this size will also become popular. The sale price of this size has been provisionally fixed at Rs 6-8-0 per ft.

SELECTED ARTICLES

RECENT ADVANCES IN FUMIGATION AND THE NEEDS OF FUMIGATION PRACTICE

BY

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Contents

INTRODUCTION

FUMIGATION is now one of the most widely-used methods of dealing with the insect-infestation of stored products of all kinds, but despite its wide use and the relatively long time during which it has been practised it is still too largely employed empirically.

Naturally, the object of fumigation being the destruction of insects, it is generally assumed that if and when this has been attained, no other questions arise. Fumigation is, however, a much more complex process than that assumption suggests. Recent work has shown that the scientific and practical problems underlying fumigation are two-fold. First there are the factors governing the toxicity of gases or vapours to insects and, second, those governing the amount of residual fumigant left in the goods after fumigation.

GENERAL PRINCIPLES OF FUMIGATION

In considering the toxicity of fumigants to insects we have until quite recently had no general principles to guide us, but now we are beginning to see some general laws which explain the apparently diverse phenomena presented. A review of published work on the toxicity of fumigants to insects shows that, apart from variation of toxic action according to the species and stage of development of the insect, there is another kind of variation which has hitherto proved puzzling. If two batches of the same species of insect in the same stage of development

are fumigated at different temperatures, those fumigated at the higher temperature will succumb more rapidly than those at the lower. Further if, prior to fumigation, two batches of similar insects are kept at different temperatures but are then fumigated at the same temperature, those kept at the higher temperature prior to fumigation will succumb more rapidly than those kept at the lower. Again, if of two batches of similar insects one batch is starved prior to fumigation while the other is fed, the insects in the fed batch will succumb more rapidly than those in the starved batch. These three results at first seem to have no relation to one another, but considered with other results recently obtained by Mansbridge on the effect of heat on insects, it seems that the toxicity of a fumigant varies directly with the rate of metabolism. The more rapid the metabolism the higher the toxicity. This assumption raises a number of interesting problems in insect physiology which must be investigated before the action of fumigants is fully understood, but meanwhile I think we may take it as a working principle in fumigation that toxicity varies directly with rate of metabolism.

What importance this has in practical fumigation is fairly evident, although it is not yet sufficiently realised. Fumigation is most extensively practised in the United States in the warmer months or in warm countries when and where insect metabolism is high and toxicity is, therefore, as we now suggest, also high. In fumigation in winter or in colder countries we find the reverse, as insect metabolism is low and toxicity is correspondingly low, and this is a point of especial practical importance in this country and in Europe generally. The poor toxicity of fumigants at low temperatures has been too little appreciated by practical fumigators, and I would like to stress its importance. One of the most difficult problems in practical fumigation in Europe is how to deal with the hibernating insect and it is obvious that the problem is that same one of low metabolism producing low toxic action. Its practical import is that more attention must be given to the heating of fumigation chambers.

Auxiliary fumigants

One other question arising from the toxicity problem deserves consideration, namely, the use of so-called auxiliary fumigants and of vacuum chambers. Auxiliary fumigants are those which have as their object the enhancing of the effect of the fumigant proper, and their action is supposed to be that they cause the insect to keep open its spiracles or breathing apertures. In general, most insects in the presence of an excess of CO_2 open their spiracles and it is suggested that, if insects are first subjected to "pre-fumigation" with CO_2 and then to fumigation with HCN (or other standard fumigant) then the HCN will penetrate more rapidly and its effect be enhanced. In this instance CO_2 is described as the auxiliary fumigant and other gases than CO_2, and certain vapours, have been proposed and tried as auxiliary fumigants. There is no doubt that auxiliary fumigants deserve the fullest consideration. Anything which will reduce the amount of highly toxic

fumigant required has enormous value in reducing the dangers attendant on fumigation. The question arises of how far we can assume that auxiliary fumigants are really effective, and how far our knowledge of the action of fumigants can help in finding suitable auxiliaries.

The basis of auxiliary fumigation is the "diffusion theory" of insect respiration, and especially that part of it which assumes that diffusion of oxygen into the insect body takes place mainly, if not wholly, through the spiracles or openings of the respiratory system, and that when the spiracles are closed no diffusion of gases into the insect body takes place, although CO_2 produced in the body may, to some extent, diffuse outwards through the insect skin or cuticle. On that theory it is to be supposed that by closing its spiracles the insect can protect itself against the ingress of toxic gases, at least for a time, and so far that time "resist" fumigation. On the other hand, it is assumed that in the presence of excess of CO_2, insects automatically open their spiracles and keep them open while the excess persists, and it is suggested that if this condition is created and a fumigant gas is then introduced it should rapidly enter the insect body and cause death.

Now although the work of Krogh, Hazelhoff and notably the recent work of Wigglesworth, has greatly advanced our knowledge of insect respiration, a review of the published work on the subject shows that it is more complex than is generally assumed, and that we cannot generalise yet about the mechanism of respiration. Only recently Fraenkel and Herford, working in my own department, have shown that, in some insects, in certain circumstances, oxygen can and does enter the insect body by diffusion through the skin or cuticle, and that in some insects as much as 25 per cent of the oxygen "uptake" may be so obtained. That figure for diffusion of oxygen inwards through the cuticle is the same as that given by Buddenbruch and Rohr as the quantity of CO_2 normally diffusing outwardly through the cuticle of certain insects. These results of Fraenkel and Herford, if confirmed and extended, must cause us to review the whole question of auxiliary fumigants and, in my opinion, until further work has been done on the diffusion of gases through the insect cuticle, no useful purpose can be served in seeking new auxiliary fumigants or in urging their use.

Vacuum fumigation

Vacuum fumigation in so far as it affects toxicity is open to the same criticism and, as I hope to show when dealing with the problems of residues following fumigation, there are other ways in which practical fumigation can be developed pending a fuller study of insect respiration and its bearing on fumigation practice. Further, in vacuum fumigation there are other factors involved which are evidently more important than the physiological factor. Meanwhile too, it is worth while to note that the effects of reduced pressures, even of greatly reduced pressures, on insects are far less important than the effects of reduced pressures on mammals.

To sum up the question of toxicity we may say that the toxicity of a fumigant to insects varies directly with the rate of metabolism ; that enhanced toxicity can be obtained by artificially increasing the metabolic rate by raising the temperature either prior to or during fumigation, and that further development of methods of enhancing toxicity by auxiliary fumigants, by using low pressures or by other means, depends on and awaits fuller knowledge of insect physiology and especially of insect respiration.

Residual fumigant

We may now consider the question of residual fumigant. It is only now receiving the attention it deserves, but it is a large question and I can only outline some of the more important problems it presents.

The amount of residual fumigant left after any operation depends on a number of factors, namely :—the mode of distribution and degree of penetration of the fumigant, both in the chamber and in the goods contained in it ; the extent to which the fumigant is absorbed on the walls of the chamber and on the surfaces of the goods, and on its absorption by the goods and, finally, it depends on the rate at which, and extent to which the adsorbed and absorbed fumigant is given off again when ventilation follows fumigation.

Recently Page and his co-workers in my department have considerably advanced our knowledge of the distribution and penetration of gases during fumigation. In modern practice on a large scale, the fumigants are commonly employed in liquid form under pressure. When this is released they evaporate and disperse, first into the air space and then into the goods. At low temperatures, the amount of heat taken up by the liquid fumigant in evaporating may so reduce the temperature in the neighbourhood of the release jet that the fumigant may condense again, and this is one cause of poor dispersal of the fumigant and of its high concentration in the region of release. Apart from this, low temperatures generally reduce dispersal and Page and Lubatti have devised special vaporisers to overcome this difficulty with ethylene oxide. Imperial Chemical Industries, Ltd. has also devised an electrical vaporiser for use with HCN.

Distribution of fumigant

Assuming that evaporation is secured, the next requirement is that distribution of the gas should be uniform throughout the chamber. Uniform distribution is too readily assumed to occur as a matter of course, but sampling of the air-gas mixture even in small chambers, shows that it is by no means easily attained, whilst in larger chambers and in warehouses special measures must be taken to secure even moderately uniform distribution and concentration of the gas.

Until recently the chief difficulty in determining the distribution and concentration of gas attained was the lack of rapid and easily applied methods of sampling. The withdrawal of samples and estimation of them by aspiration is not wholly

satisfactory, and a modification of the vacuum bottle first devised by Monier Williams has recently been made by Page, and more recently further improved. By the method of sampling, Page and Lubatti have made useful studies of the distribution of fumigant gases in empty warehouses and in barges laden with dried fruits. Their results show that even distribution and uniform concentration of the fumigant throughout the chamber warehouse or barge can be attained only under skilled supervision and that regular sampling must be undertaken to avoid imperfect dispersal resulting from faulty release of the gas, leakage, too dense packing of goods and strong air currents or winds. In chamber fumigation the working out of a system to ensure good distribution can readily be attained by using sampling methods as a guide, while recently a German firm has marketed a special "circulatory system" chamber which, it is claimed, ensures regular distribution and concentration of fumigant throughout.

In an empty chamber, the main factors affecting distribution of the fumigant are the method of release of the gas, the resistance offered to its passage by the walls of the chamber and the adsorption of it by the walls of the chamber. In a charged or loaded chamber, still other factors come into play : the resistance offered by the various sized passages between the packages or in the goods themselves, the resistance offered by the various surfaces of the packages and/or of the goods themselves and, finally, the varied degree of adsorption and absorption of the fumigant by packages and goods.

The smaller and more resistant to the passage of the gas the interspaces in the packages or goods are, the greater will be the adsorption and absorption of it where resistance to passage is high. The more gas is held up by "sorption" the less will be available to destroy the insects. Adsorbed or absorbed fumigant has no immediate insecticidal value. The more gas adsorbed or absorbed, the greater will be the amount of residual fumigant to be dispersed after fumigation ceases. For these reasons it is obvious that rapid and even distribution of the fumigant is of the highest importance and presents problems deserving the fullest consideration by the chemical engineer.

Dispersion of residual fumigant

So far I have considered the process of fumigation itself, but the ventilation of the chamber and its contents after fumigation is almost equally important. The dispersal of the free fumigant is a relatively simple matter ; the serious question is to disperse the adsorbed and absorbed residual fumigant. On this problem there is urgent need for more knowledge and more experimental work, and I may briefly indicate the lines along which useful work can be done apart from the longer range or more fundamental research required for the better understanding of adsorption and absorption. The first line of investigation obviously should be the experimental study of various methods of packing and piling goods for fumigation. Preliminary work by Page and Lubatti has shown that much can be done

to enhance penetration and reduce adsorption and absorption by improved piling of goods. More recent work by them shows that a surprisingly large amount of fumigant is adsorbed by the wooden packing cases—the 28 lb. and 56 lb. boxes commonly used in the dried fruit trade—and it shows that here is an important field for experimental work.

One method claimed as a means both of improving the toxicity and penetration of the fumigant, and of eliminating residual fumigant after fumigation, is the vacuum method. I should like to advise caution regarding this method. Work in progress in my department, but still too incomplete for publication or discussion, suggests that fumigation under vacuum may not be so markedly better than normal pressure fumigation as to justify its increased cost. Here, however, is an obvious field for experimental work. The removal of residual fumigant is to-day almost as important as increase in toxicity of the fumigant itself. Fumigation is not a popular practice in this country, but it is rapidly extending and its ultimate success depends almost more on improved methods of removing or reducing residual fumigant than on any other factor.

Conclusion

To sum up the present position in fumigation, two main lines of work are necessary: basic or longer range research in insect physiology and especially in insect respiration, and basic research on the adsorption of gases by various foodstuffs and other produce, and by packing materials and *ad hoc* experimental work on methods for improving the dispersal and penetration of fumigants, for reducing the degree of their adsorption and absorption by goods and containers, and for ensuring more rapid and complete removal of such residual fumigant as may still be formed.

Summary

The complexity of the fumigation process is shown, and the general principles of application are discussed, particularly with reference to the beneficial effect of heat. An account is given of the action of "auxiliary" fumigants, and it is pointed out that the effect of vacuum fumigation may be less important than has been supposed. The author outlines the position of the study of residues left after fumigation from the standpoint of the distribution and penetration of gases during fumigation, and it is pointed out that special measures may be required to secure even moderately uniform concentrations of the gas. The importance of methods of sampling in this connexion is made clear and the attention of the chemical engineer is drawn to the need for securing rapid and even distribution of the fumigant, and for the study of various methods of packing and piling goods for fumigation, and of improvements in means for ensuring complete removal of residual fumigant.

THE INFLUENCE OF MACHINE-MILKING UPON MILK PRODUCTION

BY

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(Reprinted from *New York State Agricultural Experiment Station Bull. No. 654, July 1935*)

Previous observations

Just 22 years ago last November this Station published a very extensive long time investigation on machine-milking in which the conclusion was drawn that cows produced equally well when milked either by machine or by hand. The same make of milking machine has been in continuous use here for 27 years, and the same herdsman who operated the machines for most of these early experiments also operated the milkers for the tests made in recent years.

At that time, milking machines of the suction type were new and the problem was principally one of determining their practicability from the viewpoint of milk production and quality. At the present time, the milking machine is well established as a practical time-saving machine and there is no reason to question its economic value. From an experimental standpoint the problem today is one of extra refinement in technic to secure more accurate data to establish small influences on milk yield which may have been overlooked in earlier experiments.

It should be pointed out, however, that Smith and Harding,[1] and others, did appreciate the variety of uncontrolled factors which might affect their data. After carefully reviewing previous investigations on the influence of milking machines on milk flow, they stated that these earlier studies were of too short duration to be of permanent value except to show that the milk production of some cows is sometimes affected by changing from hand to machine-milking.

They milked half the herd by hand and half by machine, alternating the method of milking for each lactation period for 5 years. To milk the cow and transfer the machine to another cow required 11·7 minutes. The records of 29 cows were secured for 88 complete lactation periods. These records varied so greatly that some were eliminated for evident reasons, such as (1) loss of one or more quarters from mastitis, (2) only one lactation available due to sterility, (3) failure to end

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[1] Smith, G. A., and Harding, H. A. *New York Agr. Exp. Sta. Bul. No. 353, 1912.*

a normal lactation due to abortion, and (4) indigestion which reduced yearly production of milk below 2,000 pounds. These eliminations reduced the number of cows to 11 and the lactation periods to 43. The authors stated that 20 per cent of all lactations were started without a preliminary dry period, but the records were included as this disturbing factor was evenly divided between the two groups. An examination of the data shows that 10 of the cows were used for two lactations only, while the balance of the records were for three consecutive lactations and no corrections were made for their variable ages. Furthermore, the lactation periods varied from 295 to 365 days, the period of pregnancy during the lactation period was not considered, and the dry period varied from 0 to 108 days. Smith and Harding appreciated the desirability of controlling these factors but could not do so. They stated that " the chances are about two out of three that a little more milk will be obtained by hand milking." but concluded that milking machines did not affect milk production. They might have added, however, that the influence of the machines may have been overshadowed by these uncontrolled factors. This early work was undoubtedly particularly valuable and conclusive in spite of the irregularities.

More recently, Woll[2] of California collected extensive data from cows milked for complete lactation periods by hand and by various machines in the University herd. The data were for 65 complete lactation periods for 45 cows and the records for machine and hand milking were not usually made with the same cows. Furthermore, uncontrolled factors were recognized, as in the early work at this Staton. Woll concludes that the machines did not affect milk production.

Numerous literature citations might be given for long-time and for short-time tests, but in the main the conclusions are similar and uncontrolled factors were always involved in the long-time tests. In some short-time tests, like those of Lush of Texas,[3] factors causing variation were carefully controlled, but the tests were of brief duration. Lush concluded that cows produced best by hand milking, but the variation may have been within the limits of experimental error.

The present study was prompted because (1) some investigators and some dairymen believe that cows maintain milk production best on hand milking, (2 uncontrolled factors have affected most of the reported investigations, (3) the cows in the Experiment Station herd did not seem to maintain milk production as well as they should, and (4) the author believed that similar results should not be observed by all investigators due to differences in machines and their methods of operation, quality of hand milking, etc.

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[2] Woll, F. W. *California Agr. Exp. Sta. Bul. No. 311, 1919.*

[3] Lush, Jay L. *Texas Agr. Exp. Sta. Circ. No. 30, 1923.*

Plan of present experiment

The Experiment Station herd of Jersey cows, except for experimental purposes, has been milked continuously by machine since 1907. Conditions of care and feeding have been very uniform, in fact the same herdsman has been in charge since April 1, 1910. As the cows have been machine milked regularly, the experiment would actually show the influence of hand milking upon the milk production of machine-milked cows.

In recent years the policy has been followed to breed all cows to calve every 12-month period and to begin drying off all cows just 2 months previous to parturition, except for those few cows which through irregularity in conception were milked for 12 months. In such cases the drying off was started 2½ months before the next calving. This practice established a uniform dry period. The length of the lactation period was nearly always 10 months, but 15 per cent was deducted for 365 day records to reduce them to a 10-months basis Cows were milked by machine at 2, 3, and 5 years of age. They were milked by hand when 4 years old. Each method of milking included a full lactation period. Only one or two cows were milked by hand per year and a 4-year-old cow which was not one of the experimental cows was being milked by machine at the same time to observe any seasonal, feed, or other change which might affect the results. It is obvious that another group of cows should have been milked continuously by hand and at 4 years of age by machine to serve as a control, but sufficient labour was not available to do so.

The cows did not suffer from indigestion ; there were no abortions ; no quarters were lost from mastitis ; and, except for one case which did not seem to affect production, there were no visible flare-ups from this disease in the cows used for the experiment. Lactation periods were of uniform length or calculated to 305 days, dry periods were uniform, and the number of days the calf was carried during the lactation period was fairly uniform. Exceptions to the dry period were two yearling heifers shown in Table 1 which were given two extra weeks dry due to their young age. Seasonal variations were averaged out by covering many years in the test and by milking other cows by machine at the same time as the cows were milked by hand. So far as is known, all factors except the method of milking have been held reasonably constant. There was one undesirable factor in management which should be mentioned. All cows were milked each day by two different men and each week by three different men. Whether the machine or hand milking can best adjust itself to this irregularity the author ventures no guess, but the hand-milked cows were subjected to the greater irregularity in this respect.

The data secured permit comparisons in two ways. In the first place, the 4-year-old record of a cow by hand milking can be compared with her 2-, 3-, and

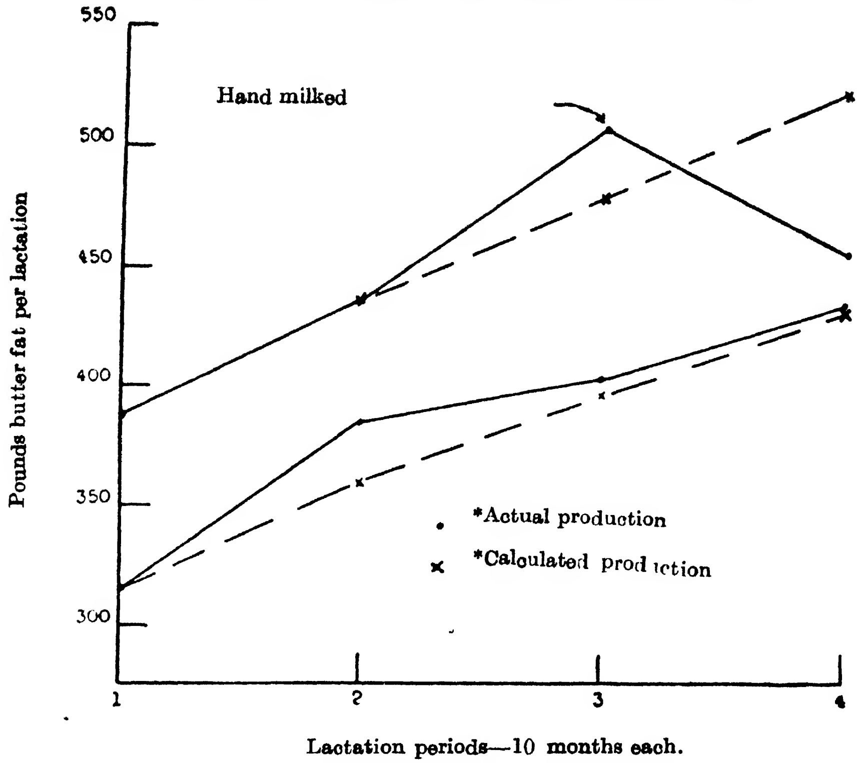

FIG. 1.—Production in pounds of butterfat for four consecutive lactation periods for seven cows milked continuously by machine except for being hand milked during the third lactation, and for seven cows milked continuously by machine. The calculated production based upon the 2-year-old records is also given for comparative purposes.

5-year-old records made by machine. Then, her production month by month can be compared for machine and for hand milking to determine persistency of production.

RESULTS

Yearly production records

Complete production data for seven cows for four lactation periods each, a total of 28 lactation periods, are presented in Table I and in Fig. 1. These cows were milked by machine for the first two and for the last lactation periods, being hand milked during the third period. Complete production data secured by machine milking only for another lot of seven cows for four lactation periods each, a total of 28 lactation periods, are presented in Table II and Fig. 1. Each cow in this second lot, except cow No. 1, was a paternal sister of the correspondingly numbered cow in Table I and the dams of each cow were also related. Each cow

in Table II, except cow No. 1, was born within 12 months of the cow bearing the same number in Table I. A total of 14 cows and 56 lactation periods are presented.

For comparative purposes the production records of each group made at 2 years of age have been calculated by age conversion factors developed by the American Jersey Cattle Club to give expected production at 3, 4, and 5 years of age. These calculated productions are also given in the tables and figure just referred to.

A study of these data clearly shows that the butterfat content of the milk was not affected by the method of milking and needs no further consideration.

In the case of the seven cows milked by hand as 4-year-olds, their butterfat production during the second lactation was exactly as expected, the butterfat yield for the third lactation period when milked by hand was 22 pounds higher, while the fourth lactation with machine milking was 67 pounds too low. The small increase above normal during the third lactation period may be within the laws of chance. That the method of milking affected production, however, is clearly shown by the fact that each of the seven cows gave more butterfat as 3-year-olds than as 2-year-olds on machine milking in both instances; that on hand milking as 4-year-olds, six out of seven produced more butterfat than when 3 years old; but that as 5-year-olds on machine milking six out of the seven cows gave less butterfat than when milked by hand at 4 years of age. Obviously, the effect of age on production was completely reversed by the machine milking following hand milking.

TABLE I

Butterfat production and test of the milk per 10-month lactation period for seven cows milked during the third lactation period by hand, the other three lactation periods being milked by machine

Cow No.	Age of cows at beginning of each lactation				Per cent fat for each lactation				Pounds fat for each lactation			
	1	2	3*	4	1	2	3*	4	1	2	3*	4
1 . . .	1-10	2-11	4-0	5-1	6·31	6·07	5·98	5·88	371·3	408·0	554·3	542·4
2 . . .	2-2	3-3	4-3	5-3	5·86	5·95	5·62	5·36	347·5	399·4	492·3	343·8
3 . . .	2-1	3-1	4-4	5-6	5·22	5·30	5·09	5·17	533·9	541·0	502·5	516·7
4 . . .	2-3	3-4	4-5	5-10	5·58	5·34	5·15	5·26	390·0	415·5	442·6	354·3
5 . . .	2-6	3-6	4-8	5-8	6·17	5·82	6·28	5·54	305·1	336·0	458·0	174·5†
6 . . .	2-4	3-4	4-5	5-6	6·14	5·93	6·16	5·28	414·6	491·4	578·6	536·2
7 . . .	2-0	3-0	4-2	5-5	6·19	5·87	5·92	6·14	357·2	460·4	508·8	451·4
Av. . . .	2-2	3-3	4-4	5-5	5·92	5·75	5·74	5·52	388·5	435·9	507·3	457·5
Expected production based upon conversion factors									388·5	437·0	485·5	524·4

*Hand milked.

† Not used in averages. This cow began her fourth lactation with a production comparable to that of the second, but the monthly decrease was large and she was practically dry in the seventh month. No reason was discovered for the unusual monthly decrease in production.

TABLE II

Butterfat production and test of the milk per 10-month lactation period for seven cows milked continuously by machine

Cow No.*	Age of cows at beginning of each lactation				Per cent fat for each lactation				Pounds fat in 10 months for each lactation			
	1	2	3	4	1	2	3	4	1	2	3	4
1	1-10	3-1	4-2	5-9	5·75	5·96	6·14	5·93	264·9	318·4	368·5	464·1
2	2-0	3-0	4-0	5-0	6·11	5·92	5·74	5·27	239·4	297·0	379·2	355·7
3	2-2	3-3	4-3	5-6	5·95	6·20	6·00	5·91	286·0	356·2	367·0	400·5
4	1-10	3-0	4-1	5-2	5·93	5·86	5·71	5·46	308·9	396·7	388·1	440·5
5	2-4	3-4	4-4	5-6	5·51	5·42	5·54	5·31	340·8	423·1	436·1	426·1
6	2-5	3-5	4-5	5-8	5·40	5·24	5·41	5·12	316·8	406·7	414·0	443·9
7	2-1	3-1	4-1	5-2	6·16	6·09	6·00	6·02	452·6	491·0	475·0	511·4
Av.	2-1	3-2	4-2	5-5	5·83	5·81	5·79	5·57	315·6	384·1	403·9	434·6
Expected production based upon conversion factors									315·6	357·5	397·5	430·0

* Each cow is the paternal half-sister of the cow in the same position in Table I and was born within 12 months of her half-sister with the exception of the first cow which is the first calf daughter of the first cow in Table I.

It was not originally intended to use any data except from the cows in Table I, but the records of cows in Table II were compiled later for comparative purposes. Their lower production is not entirely accidental as cows which gave less than 300 pounds of butterfat in 10 months at 2 years of age were excluded from the hand milking experiment. Table II and Fig. 1 clearly show no irregularity in these production records of cows always milked by machine, except for an increase of 26 pounds of butterfat above normal at the age of 3 years. There was no drop in the 5-year-old records as was the case when the hand-milked cows were milked by machine. It should be borne in mind that the 5-year-old cows of corresponding numbers in each table were in the barn at the same time so that seasonal or feed conditions were uniform.

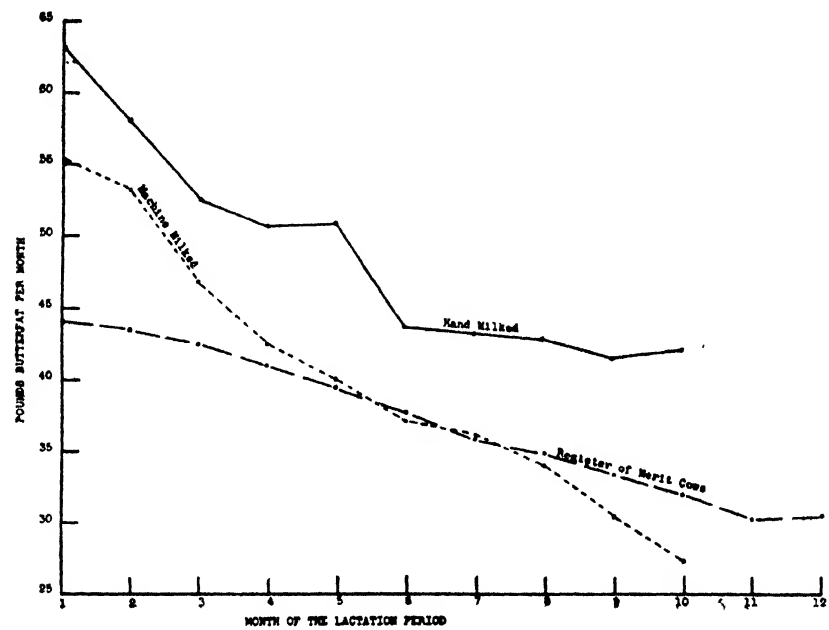

FIG. 2.—Monthly butterfat production in pounds of butterfat for the seven cows milked for three complete lactation periods by machine and for one complete lactation period by hand.

The monthly butterfat production for Register of Merit cows is given for comparative purposes.

Monthly production records

The butterfat production records of the seven cows which were milked by hand at 4 years of age were averaged on a monthly basis for each lactation period and the three lactation periods of machine milking were averaged together on a monthly basis. These data are given in Table III and are graphically represented in Fig. 2.

TABLE III

Average butterfat production in pounds per month on basis of lactation periods for seven cows milked during the third lactation by hand, the other three lactation periods being milked by machine

LACTATION PERIOD AND METHOD OF MILKING	LACTATION MONTH									
	1	2	3	4	5	6	7	8	9	10
First, machine milked	44·8	42·9	38·4	34·1	33·5	31·2	31·6	30·2	27·9	26·4
Second, machine milked . . .	60·7	57·9	48·0	43·8	41·1	40·1	36·3	33·8	30·1	27·0
Fourth, machine milked* . . .	61·6	59·4	54·9	50·9	44·4	40·6	41·1	38·1	34·2	29·1
Av. for 3 lactations (machine) . .	55·4	53·1	46·7	42·5	40·0	37·1	36·1	33·9	30·5	27·4
Third, hand milked	63·1	58·4	52·4	50·7	51·1	43·7	43·1	42·8	41·7	42·1

* The record of cow No. 5 was not used in this average as it was abnormally low due to lack of persistency from month to month.

TABLE IV

Monthly production records for Register of Merit Jersey cows

MONTH	WEIGHT OF MILK, DAILY*	PER CENT FAT†	LBS. FAT PER MONTH
1 . . .	30·0	4·90	44·10
2 . . .	29·4	4·93	43·48
3 . . .	27·9	5·09	42·60
4 . . .	25·9	5·27	41·10
5 . . .	24·2	5·43	39·42
6 . . .	22·7	5·51	37·52
7 . . .	21·4	5·57	35·75
8 . .	20·6	5·62	34·73
9 . . .	19·5	5·69	33·29
10 . . .	18·6	5·74	32·03
11 . . .	17·3	5·81	30·15
12 . . .	17·3	5·89	30·57
Yearly . .	8244·0	5·41	444·74

* Based upon 13,823 Register of Merit records as compiled by A. C. Ragsdale and C. W. Turner. *Jersey Bulletin and Dairy World*, Apr. 18, 1923.

† Based upon 3.202 yearly (1928-30) Register of Merit records as compiled by Lynn Copeland. *Jersey Bulletin and Dairy World*, Sept. 30, 1931.

For comparative purposes, monthly production records for Register of Merit Jerseys were desired but were not available. Therefore, available data on the daily milk production on a monthly basis and the monthly test averages were used to compute the monthly butterfat production. These data are presented in Table IV and Fig 2. The data for Register of Merit Jerseys are not comparable to those secured in these experiments as the former were for 12-month periods with much

longer intervals between calvings. Milking was done by both machine and by hand. Conditions of feeding, environment, etc., would also produce variations which would make direct comparisons less reliable.

To eliminate variations in butterfat production per month due to the level of production, the data are also given on a percentage basis, taking the first month production as 100. These data are given in Table V and Fig. 3.

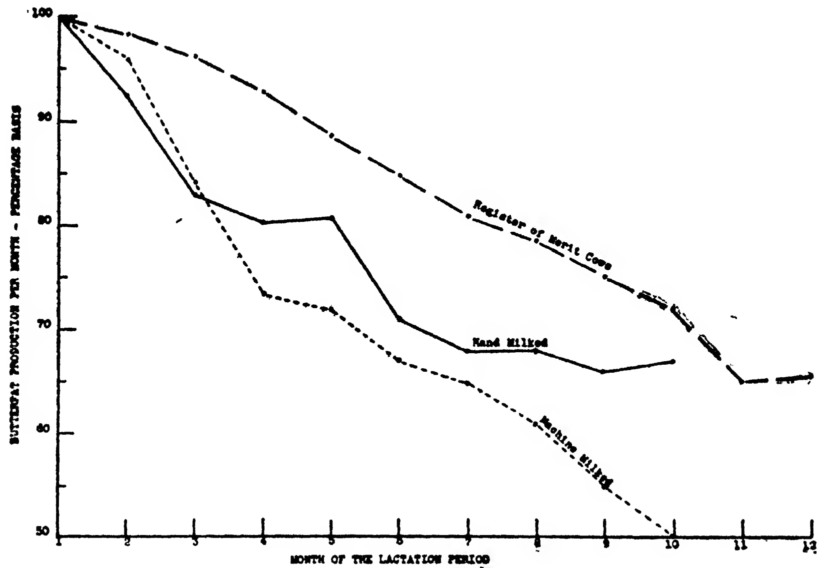

FIG. 3.—Monthly butterfat production given as percentages of the first month's production which was taken as 100 for the seven cows milked for three complete lactation periods by machine, and for one complete lactation period by hand.

The monthly butterfat production for Register of Merit cows is given for comparative purposes.

TABLE V

Average butterfat production per month expressed as percentages of the first month's production which was taken as 100 for machine-milked and hand-milked cows in the station herd and for Register of Merit Jersey cows

METHOD OF MILKING	PRODUCTION PER MONTH WITH FIRST MONTH TAKEN AS 100											
	1	2	3	4	5	6	7	8	9	10	11	12
Exp. Station Jerseys :												
Machine milked, first lactation.	100·0	95·7	85·7	76·0	74·7	69·6	70·5	67·4	62·2	58·8	..	..
Machine milked, three lactations.	100·0	96·0	84·2	73·2	72·2	66·9	65·1	61·1	55·0	49·4	..	..
Hand milked . . .	100·0	92·5	83·0	80·3	80·9	70·8	68·3	67·9	66·0	66·7	..	..
Register of Merit Jerseys :												
Hand and machine milked .	100·0	98·5	96·5	93·1	89·3	85·0	81·0	78·7	75·4	72·6	68·3	69·0

The monthly butterfat production records clearly indicate that for the first three months of the lactation period the cows produced rather uniformly on machine and hand milking, but beginning with the fourth month the cows which wee rmilked by hand maintained a higher level of production which was particularly evident in the eighth, ninth, and tenth months. This difference is evident even from a casual observation of Fig. 3 which gives the production on a percentage basis. A point which may have some significance is the more persistent production of heifers milked by machine as compared with the production of old cows when milked by machine.

The decrease in production for cows milked by machine was very uniform from month to month, while the cows milked by hand showed a similar decrease during the first 3 months and a uniformly more persistent production thereafter. The monthly decrease in production was far less for Register of Merit cows than for the cows in this experiment. However, the monthly decrease for the hand-milked cows from the fourth through the tenth month was not quite as great as for Register of Merit cows.

The reason that the cows produced more as 4-year-olds on hand milking as compared with their production on machine milking at 5 years of age is now self-evident, namely, production was maintained with greater persistence throughout the lactation period. The monthly butterfat production for these two ages was almost identical for 4 months, but during the fifth month and thereafter through the tenth month the 4-year-old cows milked by hand produced more than they did when milked by machine at 5 years of age.

DISCUSSION AND CONCLUSIONS[4]

That milk production was more persistently maintained through the lactation period when the cows in this experiment were milked by hand, there can be no question. Furthermore, the monthly decline in milk production became greater as the cows were milked by machine during subsequent lactation periods. The percentage of butterfat was not affected by the method of milking.

The author does not believe that the results affect the extent to which milking machines should be used on the farm, as differences in total production per cow were small, but rather that they should stress the need for care in the operation of

[4] While this bulletin was in process of publication, two articles have appeared which confirm the conclusions reached here. In Hansen's *Dairy Bulletin* for June and July 1935, work is reported from the Royal Veterinary and Agricultural College of Copenhagen which shows that hand-milked cows were more persistent in production after approximately the third month of the lactation period. In *Agricultural Progress*, 12, 1935, Bartlett and Huthnance of the National Institute for Research n Dairying, University of Reading, found that a difference in production between machine- and hand-milked cows began to show in favour of hand milking after the fifth week and that this difference gradually increased throughout the entire lactation period.

these machines. The results secured might be affected by the breed of cattle, the skill of the person milking by hand, the make of milking machine, etc., so that exact uniformity from farm to farm should not be expected.

In the course of other experiments data were secured on the time required to milk the cows by machine. It was found that the machine was left on all cows for at least 6 minutes and on some cows for more than 10 minutes, although on most cows for 9 or 10 minutes. About 2 to 2½ hours were required to milk 25 cows using two single units, or 10 to 12 cows per hour. About 1 minute was required to change the machine from cow to cow so the machines were on the cows on an average of 9 to 10 minutes. It is a human tendency to do things in the easiest manner and the machine, therefore, was left on each cow until she was practically dry. Then the udder of the cow was massaged for a fraction of a minute by hand and finally if any milk still remained in the udder it was stripped by hand into the teat cups of the machine. By this method a man can milk as many cows more easily, especially if using three units, as by any other method of operation. It is believed by the author that this practice is fundamentally wrong from the standpoint of maximum production and accounts for the small decrease in production secured by machine milking, even though it has always been the practice followed in the Experiment Station herd.

The author believes that the withdrawal of milk from a cow by machine is as satisfactory as hand milking as long as appreciable amounts of milk remain in the udder. The removal of all milk, except for less than a half pound, is probably accomplished within 5 minutes for most cows. Thereafter the vacuum is applied directly to the soft tissues within the udder. Continued suction on a thin membrane tends to draw blood to the point of suction, an action which can be demonstrated by applying the vacuum from the milker to human skin not browned by the sun and wind. When this suction is continued for 3 or 4 minutes after the completion of each milking twice a day, it is reasonable to presume that after several months the tissues thicken and harden. Such an effect might be expected to develop difficult milking and reduce production. Irrespective of the lack of any definite evidence for these assumptions, these effects of machine milking on milk production seem reasonably well established from the limited data presented.

This investigation is now being repeated using the following procedure for operating the machines with the expectation that production will be maintained by machine milking as well as by good hand milking. The machines will be left on the cows for the minimum period required to secure most of the milk or for a definite time interval when they will be promptly removed and the milking finished by hand. It is expected that the time the machines will be left on the cows can be reduced nearly one-half, which will be from 4 to 6 minutes per cow. The operator will be kept busy continuously changing machines and stripping by hand. Some months may be required for the cows to become well enough adjusted to the

change to limit excessive stripping, but whether stripping is excessive or not this procedure will be tried for experimental purposes.

Repeated observations indicate that heifers milked easier and more quickly than old cows, indicating that the cows gradually adjusted themselves to become slow hard milkers. The milking by hand of these cows which had been previously machine milked was often rather difficult for 2 or 3 months, after which the milking could be done in a reasonable period of time. It is very probable that the hand-milked cows required the first 3 or 4 months of their lactation period to adjust themselves from machine to hand milking.

SUMMARY

Although many investigations have established that cows produce equally well when milked either by machine or by hand, some practical observations have tended to question whether the conditions of the earlier experiments were controlled with sufficient care to show small differences. Furthermore, the method of operating the machine and the skill of hand milking should produce variations in results.

In this study cows were milked by machine at 2, 3 and 5 years of age and by hand at 4 years of age for complete lactation periods. Conditions which might affect results were held reasonably uniform, such as length of lactation period, length of pregnancy during lactation period, the dry period, conditions of feeding and management, age of cows, freedom from disease, method of operating the machines, type of machine, and the method of milking by hand.

It was found that the percentage of milk fat in the milk was not affected by the method of milking. Slightly more milk was given by the cows milked by hand, but the difference in production was evident only after the third month of the lactation period. The hand-milked cows were more persistant in maintaining production throughout the lactation period. It is believed that this observation was due to the relatively long time the machine was left on the cows and should indicate the desirability of removing the machine from the cow as soon as possible.

These results are not interpreted as being adverse to the use of milking machines, but rather to emphasize the need of correct operation.

INSECT DAMAGE TO EMPIRE PRODUCTS

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ALTHOUGH the depredations of insects on growing crops have long received attention and agricultural entomology is throughout the Empire a highly valued and reasonably well-supported branch of biological science, the depredations of insects on harvested produce have been strangely neglected. Except in times of stress as during the Great War losses to produce in store have been accepted as a necessary evil, and stored products' entomology has until quite recently existed rather as a branch of applied entomology cited in the text books than as a really active field of work. Since the war, economic conditions have forced a fuller recognition of the insect problems arising in the storage, transport and marketing of Empire produce and stored products entomology is slowly receiving recognition.

I propose briefly to describe what these insect problems are, how far they are being tackled in the Empire, and what work and organisation is still necessary for reasonably good control of insect infestation of stored foodstuffs and other raw materials.

Nearly all kinds of organic produce suffer from insect infestation during storage, but naturally the greater the volume of the product and the greater its value, the more evident is the infestation. With the exception of tea, all the more important Empire products suffer more or less severely, notably cocoa, dried fruits, nuts and spices, tobacco, and grain. Infestation of these commodities may occur at any stage in the handling of them after harvesting and, broadly speaking, we may say that infestation in the producing country, both prior to and during storage there, on shipboard or other conveyance during transport, and in the exporting country during storage both at the ports and inland, is universal.

It is difficult to assess the monetary loss caused by this infestation. In the United States of America widely differing figures have been given of the annual losses in that country, ranging from millions to tens of millions of dollars. The wide disparity in the figures quoted indicates the difficulty of assessment. My own view is that the extent of financial loss should ultimately be measured by the sums which those concerned are prepared to expend in preventing or controlling loss, but even here a difficulty arises because there is a natural tendency for each branch of industry or commerce to pass its losses on to the next until ultimately

the loss may be spread very widely among the consumers. This passing of loss is, however, becoming more difficult and when, as has happened in the dried fruits, tobacco, and cocoa industries, insect infestation has become too severe to allow of the losses being passed on it is possible to get some idea of their extent. In 1929 and 1930 the value of tobacco leaf infested by the moth, *Ephestia elutella*, was reduced by 40 to 50 per cent and direct and indirect losses sustained by the tobacco trade as a result of infestation of African tobacco was, in round figures, at least £100,000. In the Australian dried fruits trade it may be sufficient to say that infestation of dried fruits by the moth, *Plodia interpunctella*, was so serious that in 1932 this fruit was being marketed with the greatest difficulty and many thousands of pounds have been spent in remedying these adverse conditions.

The insects which infest stored products do not belong to any one group; upwards of two hundred species infest or occur in the major Empire products just cited, and they represent many natural orders and families of insects. Of these, however, much the most important are the Lepidoptera, or moths, and the Coleoptera, or beetles. Of the moths members of the family Phycitidæ are especially important, and among the beetles members of the families Curculionidæ, Anthribidæ, Tenebrionidæ, Dermestidæ and Cucujidæ are the more important. In these families the major pests are the moths of the genera *Ephestia* and *Plodia*, the Curculionid beetles of the genus *Sitophilus*, commonly known as grain weevils, the Anthribid beetle *Aræcerus fasciculatus*, a serious pest of nutmegs and of cocoa, the Tenebrionid beetles of the genera *Tribolium* and *Gnathocerus*, the Dermestid beetles of the genera *Dermestes* and *Trogoderma*, and the Cucujid beetles of the genus *Oryzœphilus*.

All these insects undergo during their development what is commonly called "complete metamorphosis". They begin life in the egg stage, emerge from this into the larval stage as grubs or caterpillars, then pupate, and finally emerge as the adult or perfect insects. All growth in size of these insects and practically all feeding for development takes place in the larval stage. A knowledge of the development and biology of these insects is basic to an understanding of the measures used to keep them in check, and I think I can best illustrate the importance of this by referring to the moths of the genera *Ephestia* and *Plodia* which, as I have said, are among the most important of all the stored products insects.

The genus *Ephestia* comprises about sixty species of small moths about ½ inch long in body length and 1½ inches in wing span. Not all of them have importance as pests of stored products, and I propose to mention only two species which will illustrate their biology. The first of these is the so-called flour moth, *Ephestia kühniella Z.*, which is pre-eminently a pest of flour, but attacks all kinds of starchy foodstuffs including potatoes and soya beans. The features of this moth biologically are that in steam mills and heated warehouses, as in the laboratory, it continues to breed all the year round, giving three to five generations in the year according to the temperature prevailing. The second *Ephestia* is the so-called cocoa moth,

Ephestia elutella Hb., which is widely known as a pest of cocoa, but which has recently proved a serious pest of tobacco and attacks an enormous number of other products. This moth differs from *Ephestia kühniella* in its biology because in warm warehouses and under laboratory conditions it produces only two broods, or two broods and part of a third, during a year but never more. The second brood, and in rare cases the third brood, when they reach the final stages of larval development become dormant, or in entomological parlance go into diapause, and nothing that the entomologist can do has so far succeeded in breaking that dormancy.

The genus *Plodia*, which is very closely allied to the genus *Ephestia*, comprises only two species, of which only one is important, the Indian meal or dried fruit moth, *Plodia interpunctella* Hb. This insect resembles *Ephestia kühneilla* in its biology in that its rates of growth and reproduction are more governed by temperature than those of *Ephestia elutella*, but it resembles *Ephestia elutella* in that it goes into a dormant state in the winter time as if it obeyed a seasonal rhythm.

All three of these species when fully or almost fully grown larvæ exhibit a remarkable habit of leaving their foodstuffs and wandering widely in mills and warehouses. At the end of this wandering phase they seek some cranny or crevice into which they can tightly ensconce themselves and there pupate or become dormant as the case may be. As we shall see later, these two phenomena of going into dormancy and of wandering are of enormous importance from a practical point of view.

One other feature of the biology of these moths deserves mention. It is commonly supposed that insects which undergo complete metamorphosis emerge from pupation fully developed in all respects and require no further feeding, but in these moths some form of feeding is necessary before they can lay eggs. One of my staff, Mrs. Richards, has shown that the number of eggs laid by these moths depends on the extent to which they have access to water.

With that brief summary of the main features of the biology of these moths, I may now pass to the question of control measures used against stored products pests. I think it may be helpful if I consider first the theoretical aspects of control and then the practical. In general control measures against insects may be divided into three main groups, physical, chemical and biological. The term " biological control " has recently been used to describe the control of insects by setting their parasites against them ; this is a somewhat too restricted use of the term " biological control," but it is now so general that we may have to accept it. I may say at once that for a number of reasons this form of control is not applicable to stored products infestation ; of these the chief reasons are that stored products insects are cosmopolitan in distribution, their parasites, as we know them, are equally cosmopolitan, and finally, a very practical reason, merchants and consumers have just as much objection to the presence of parasite larvæ or cocoons

on their foodstuffs as they have to the presence of caterpillars. For these reasons I propose to confine myself to the physical and chemical control measures.

Physical control measures, in so far as they can be practised to-day, consist in the main in the use of high or of low temperatures and, to a lesser extent, of high or of low humidity . High temperatures where they can be applied are commonly used to destroy the insects outright. Low temperatures may be used both for that purpose and for so reducing development and increase of the insects as to render them innocuous until the infested products can be manufactured. During recent years a considerable amount of work has been done on the effect of high and low temperatures on insects but, at the moment, I am afraid we ought, as scientists, to admit that our knowledge of the action of high and low temperatures is far from complete. We do not yet know why moderately high temperatures kill insects. Two explanations which have been offered, that they cause death by dessication of the insects or that they cause coagulation of their protein, are not entirely satisfactory. I think it sufficient merely to mention that. Meanwhile it may be interesting to consider some of the factors which govern the effects of high and low temperatures.

Mansbridge, working in my department, has shown that the effect of high temperature on the flour moth varies with the rate of metabolism ; the higher the rate of metabolism the greater the effect of temperature.

With regard to low temperature, the early work of Bachmetjew and the more recent work of Robinson, Payne and others show that insects can withstand a gradual reduction of temperature to a degree markedly lower than that which is fatal to them if the drop in temperature is rapid. Under laboratory conditions and in field conditions where the insects are exposed to the immediate effects of fall in temperature, a rapid fall is frequently fatal to them, but where the insects occur in bales of tobacco or in bags of cocoa a sudden drop in temperature can rarely be obtained because of the lag in fall of temperature between that of the atmosphere of the chamber and of the goods treated. For example, Bovingdon has shown that it takes three weeks to cool a hogshead of tobacco from 58° Fahrenheit to 4° Fahrenheit and it is evident that under these conditions the fall must be a gradual one and the lethal temperature will therefore below.

Of the action of low temperature we know not much more than we know concerning the action of high temperature. There is some evidence that on cooling an insect tends to lose water, and if this process takes place until the only water remaining in the insect is water in a so-called bound or colloidal form the insect is remarkably resistant. If, however, the fall of temperature is rapid and the insect fails to get rid of its free water rapidly it succumbs to a higher temperature. The explanation offered for this is that where the fall in temperature is rapid, death is caused by the freezing of the free water in the insect tissues and that " bound " or " colloid " water does not freeze.

In dealing with physical methods I ought perhaps to mention reduced pressures. We know comparatively little about their effects and, except as an aid to fumigation, reduced pressures have so far been little studied as control measures.

Chemical control measures are generally described under the term "control by insecticides". Until recently the insecticides used in stored products were almost wholly vaporous or gaseous, or in other words fumigants. Of the action of fumigants on insects, in spite of much work done on *ad hoc* lines, we still have far too little knowledge. The most studied and the best understood fumigant in this respect is hydrogen cyanide, and from the work of Warburg, Keilin and others it is known that hydrogen cyanide acts by inhibiting the oxidation of the respiratory ferments or pigments. While scientifically this knowledge is very important we have still much to discover as to how hydrogen cyanide penetrates the insect tissues, and if we turn to other fumigants we have to confess that our knowledge of their biological action is almost negligible. Meanwhile, we are beginning to make a little headway in this field, and I think one of the most important advances is the suggestion, which may soon be confirmed by our own work, that the toxicity of a gas or vapour is directly proportional to the rate of metabolism of the insect. Further, partly as a result of the work of Wigglesworth and partly as a result of the extension of his work in my own department, we have good reason to hope that a number of difficulties regarding the theory of the action of fumigants may soon be cleared up. Fumigants act through the respiratory system, and it is by a fuller study of insect respiration that new knowledge of the action of fumigants will be gained.

Of the use of insecticides other than fumigants I propose only to say that recently one of my staff, Dr. Potter, has devised a very simple insecticidal spray consisting of a white paraffin carrying an extract of pyrethrum, which has proved a most useful adjunct to fumigation.

Apart from the action of fumigants on the insects, we have to consider how the fumigant reaches the insects, and in this field I think my department may claim to have made substantial advances.

In the practice of fumigation it is generally assumed that when a gas or vapour is released in a chamber or warehouse the gas gradually disperses throughout the air space and the contained goods. The rate of its dispersal and its penetration into the goods is assumed to be fairly uniform, or to become fairly uniform within periods of six or twelve or twenty-four hours—the periods of exposure commonly given in fumigation practice. The extent of degree of distribution and penetration is commonly determined by the effects of the fumigant on insects placed in various parts of the chamber and in the contained goods. If the percentage of these "test insects" killed is high the distribution and penetration of the gas is considered to be good and effective. In estimating the amount of fumigant to be used in any given process some allowance is made for leakage and for adsorption and absorption of the gas by the walls of the chamber and by the goods. In

general, however, and a recent circular on industrial fumigation against insects issued by the Bureau of Entomology of the U. S. Department of Agriculture bears this out, the allowances made for these factors affecting distribution, penetration, and insecticidal action have often no better basis than guesswork, and it is safe to say that they are nearly always wholly inadequate.

It is worth while to consider these factors affecting distribution, penetration and insecticidal action, a little more closely. First, I think we may consider the value of the methods available for studying these factors. The most obvious method is to take samples of the air-gas mixture at various points in the air space and in the goods treated. These samples may be taken in two ways, by drawing off the air-gas mixtures and aspirating it through suitable solutions or by drawing samples into a vacuum flask and then estimating the fumigant obtained. Of these two ways of sampling, the second as developed by Page and Lubatti in my department is in practice the more convenient and satisfactory. This method has been described by Page in the *Journal of the Society of Chemical Industry*. and need not be further described now.

The second obvious method of evaluating the effects of fumigation is to use "test" insects placed at various points. This is the method used in the United States and advocated by the Bureau of Entomology there, and it is recommended almost to the exclusion of gas sampling. In our experience it has grave disadvantages. In the first place the action of fumigant gases and vapours on insects varies, as we have seen, probably with the rate of metabolism of the insect, and unless that has been determined beforehand and unless it is known that it will not change under the conditions of the fumigation, no value can be attached to the results obtained The most simple proof of this I can give is that if two batches of hibernating caterpillars in their light silken cocoons are taken and if in one batch the caterpillars are removed from their cocoons and in the other they are not, those caterpillars which have not been disturbed will require, it may be as much as, five times the concentration of fumigant to kill them as those which have been disturbed. Moreover in commercial fumigation it too often happens that insects are obtained at random without any knowledge of their physiological states, and such insects are worthless for test purposes.

In our work, therefore, we have employed both the vacuum flask sampling method and the test insect, using insects of known origin and history, and it is to this simple system that I attribute our advancement of knowledge. I need only sum up the main advances we have made. We have shown that allowance must be made for variation in the purity of the fumigant: that even distribution and penetration of the fumigant requires special attention, it is rarely attained except when special methods such as the use of vaporisers and of punkahs or fans are employed; that loss of active fumigant by adsorption and absorption is far greater than is commonly assumed, and that the quantities of gas so retained by

the walls of chambers, or the fabric of buildings and by the goods themselves is also higher than is generally accepted in practice. In fact, efficient fumigation is a highly technical process and requires constant supervision. This is not the occasion on which to discuss the scientific and technical problems of the adsorption and retention of gases by various products, but I should like to emphasise the enormous importance which the study of these problems has for the control of infestation of foodstuffs and other products by insects.

I may now turn to the more practical problems of insect control, and I think I can best illustrate them by referring to our work on the control of the infestation of dried fruits by the moths *Plodia interpunctella* and *Ephestia elutella*. While in the early stages of our work on stored products when we were still getting to know something of the identity and biology of the insects and something of the behaviour of fumigant gases, we were called on by the Australian Dried Fruits Board to attempt, on a commercial scale, the control of serious infestation of Australian dried fruits. For some years previously the Board had been making strong efforts to cope with this problem, and had in fact been using fumigation as the main means of control. Despite all their efforts conditions were getting worse.

The problem as we found it was that infested fruit arrived in London, was transferred from the ships to barges and in these brought up to the wharves, where it was fumigated, and then transferred to the warehouses. If the fumigation had been successful all should have been well, but the fumigant used had grave defects which our earlier and apparently academic work soon showed. The fumigant was a mixed one and the mixture was unstable. It was, when badly mixed, a poor insecticide, and what was happening was that the barge fumigation was not efficient, and fruit still actively infested was going into the warehouses. From this fruit in the autumn the caterpillars wandered and settled in the warehouses and we were faced with two primary problems, first to ensure efficient barge fumigation and, second, to clean up the warehouses. The first problem proved relatively simple, but only after much hurried experimental work was done. We substituted the gas ethylene oxide for the mixed fumigant and, by devising a special vaporiser to ensure proper distribution of the gas, attained high efficiency.

The second problem proved much more difficult. A series of large scale experiments showed that, apart from many difficulties attendant on it, fumigation of the warehouses was impracticable because of its high cost—the warehouses ranged in capacity from 150,000 to 200,000 cubic feet. Meanwhile every crack and cranny in their fabric harboured caterpillars, and I admit that we almost despaired of dealing with that problem. In desperation, I suggested the use of a pyrethrum spray and, to cut a long story short, after much wearisome experimental work, we devised a new type of spray. We knew that it was hopeless to get any spray to penetrate every crack and cranny, and Dr. Potter resolved to tackle the moths as they emerged from these crevices. The moths have been

habit—a fortunate one for us—of flying upwards as soon as their wings are dry and they also have the habit of coming out of their pupal skins in the evening. We, therefore, used a mist-like spray which hung about as a cloud, and by sending this up after eight o'clock in the evening we killed enormous numbers of the newly emerged moths. We found that when this misty spray settled it left an invisible film on any surface it touched, and caterpillars of all sizes died if they crawled on it. A full account of this spray and its use has been published by Dr. Potter, and I need only add that as a result of our and their combined efforts in efficient fumigation and effective spraying, the Australian Dried Fruits Board have for the last two seasons sold their fruit without a single complaint of infestation, and we ourselves find their warehouses so clean that we have abandoned them entirely as a source of insects for experimental work.

Apart from dried fruits infestation we have had considerable success in dealing with tobacco infestation, and I think we may say that we do now understand the main principles of infestation control applicable to conditions in this country.

May I say just a word about infestation and its control overseas? My view is that the main difficulty there is the lack of trained staff. I feel that although we may publish all our results, these will not be successfully applied unless trained staff is available. I am glad to say that in Canada Dr. Gibson, head of the Entomological Branch, contemplates the establishment of a stored products entomology section. I heard only a month ago from Dr. Singh Pruthi, Imperial Entomologist in India, that a similar section is being formed, and in Australia the whole question of stored products infestation is receiving serious consideration, and already under the ægis of the Commonwealth Council of Science and Industry work on fumigation of fruits and in the use of our spray is being undertaken. I should like to think that our work is in part responsible for these developments.

Finally, may I add one word about the importance of this work. If ever we are faced with an international crisis leading to war, the storage of foodstuffs and other commodities will be a question of vital importance, and it is much to be hoped that it will before long receive the fuller recognition it deserves as a factor in Imperial defence.

THE COOLING OF EGGS

BY

E. M. FUNK

(Reprinted from *University of Missouri College of Agriculture, Agricultural Experiment Station Bulletin 350,* April, 1935)

ONE of the major problems of egg marketing agencies during the summer months is to assemble eggs which have been properly cooled and held at low temperatures on the farm, and to move those eggs through the regular marketing channels to the consumer without heat damage. Those eggs which go into the top grades in the principal city markets are eggs which show no effect of high temperatures. Serious damage to egg quality results if eggs are held at temperatures above 68°F, because germ development begins at that point. Much lower temperatures are desirable but if eggs can be held below 68°F damage from germ development will be prevented. Any information which contributes to a better knowledge of the subject of cooling eggs should be of value to the industry as a whole, and particularly to those interested in conducting an educational campaign on this subject.

METHODS USED IN STUDYING THE COOLING OF EGGS

The Missouri Agricultural Experiment Station has investigated the temperature changes which take place in eggs held in different containers and at various temperatures. Warm eggs were cooled by placing them in a cool basement and in a household refrigerator. Cooled eggs were subjected to warm temperatures. The effects of air circulation, insulation and types of containers were studied in the investigation. The thermo-couple potentiometer shown in Plate XI, fig. 2 was used to determine the temperature of the contents of the egg. Plate XI, figure 3 shows the thermo-couple attached to an egg in a case and a single egg on a wire tray. It also shows the incubator and refrigerator used and the containers in which the eggs were held. Using this type of thermometer the temperature of the inside of the egg can be taken at any time and under any desired condition. This type of thermometer has the advantage of being small and therefore introducing a negligible amount of heat or cold into the egg. The electrical wires were confined in a small glass tube to prevent any possible chemical reaction between the metal wires and the contents of the egg. Several hundred temperature readings taken in this manner supplied the data for the charts and tables presented in this publication.

COOLING EGGS IN AN EGG ROOM

Table I and Fig. 1 show the time required to cool eggs to different temperatures when the eggs were held in various containers in an egg room where the

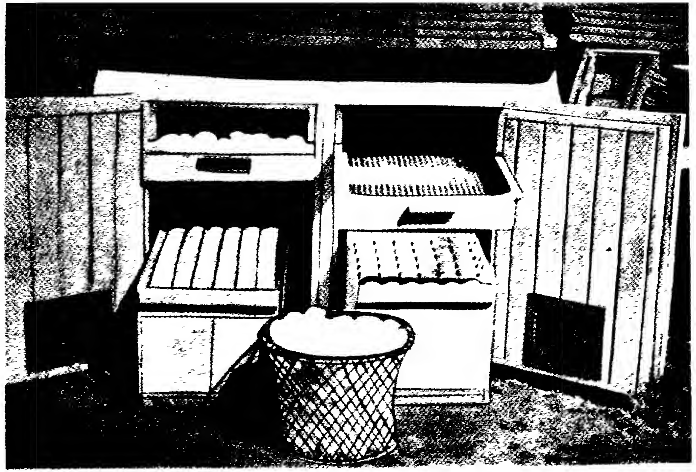

FIG. 1 The cooling of eggs

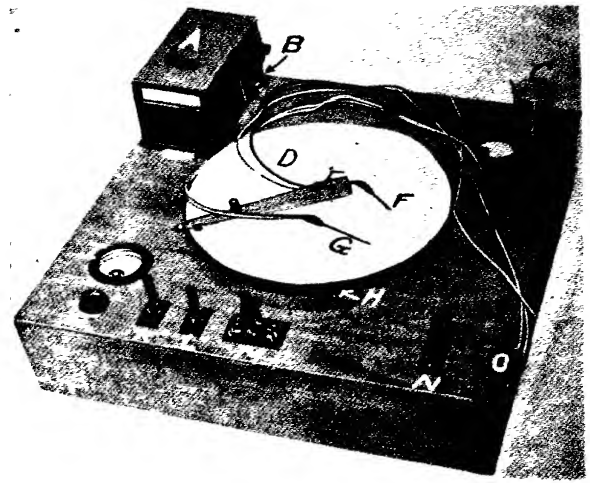

FIG. 2 Thermo-couple potentiometer used in this investigation A, galvanometer ; B, connections leading to galvanometer ; C, beaker used for holding shaved ice at 32°F. ; D, graduated dial : E, potentiometer arm : F and G, thermo-couple junctions which were inserted in eggs ; H, circle of manganin wire surrounding the dial ; I, milliameter ; J, rheostat adjustment ; K, switch controlling galvanometer light ; L, switch controlling the potentiometer current ; M, switch used for reversing the current for readings below 32°F. ; N, switch used to select thermo-couple F or G ; O, copper-constantan wires connecting the thermocouples. Three dry cell batteries which supplied the current are attached beneath the galvanometer.

FIG. 3. Thermo-couple attached to a single egg on a wire tray and to an egg in the centre of a case (one-half of a 30 dozen case). The

average temperature was 50°F. A single egg on a wire tray, three layers of eggs on a wire tray, and eggs in a wire basket, galvanised pail, chilled case, and warm case were cooled from high temperatures (92°F to 102°F) to temperatures below 60°F by holding them in an egg room (50°F). The temperature of the centre of

TABLE I

Effect of container on cooling eggs in an egg room (50°F.)

Hour	Single egg	Wire tray	Wire basket	Galva-nized pail	Chilled case	Warm case
0	101·0	102·0	100·0	98·5	97·2	92·0
1	61·1	86·9	96·0	97·9	96·2	91·8
2	51·3	74·4	87·2	95·9	94·5	91·3
3	..	66·5	79·1	92·2	92·0	90·2
4	..	61·0	72·7	87·0	89·8	88·6
5	..	56·5	67·5	82·1	87·5	86·1
6	..	55·4	63·6	77·7	..	..
8	..	51·9	58·5	70·6	..	81·0
10	..	..	56·5	65·6	76·5	75·5
12	..	..	54·7	62·2	..	..
14	..	..	..	59.8	..	69·8
18	..	..	..	..	64·5	..
20	..	..	..	..	62·2	63·1
24	..	..	..	..	59·4	59·6
28	..	..	..	..	57·0	56·7

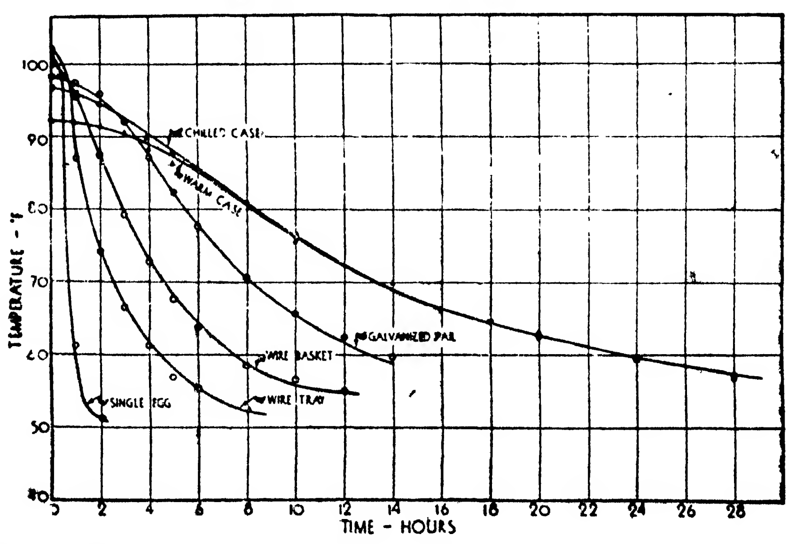

FIG. 1.—Effect of container on the rate of cooling in eggs held in an egg room (50°F).

the egg which was located as near as possible in the centre of the container was taken at regular intervals so that the rate of cooling in each instance could be determined. The results obtained do not give any new concepts of cooling but they do present data to support the logical assumptions which have been made on this subject. If we assume that the time required to cool eggs to below 68°F. is a fair measure of efficiency in cooling, we find that eggs held in different containers cooled to below 68°F. as follows ; single egg on a wire tray, one hour ; an egg in the centre of three layers of eggs on a wire tray, 3 hours ; an egg in the centre of a wire basket containing 156 eggs, 5 hours ; and egg in the centre of a galvanised pail containing 156 eggs, 10 hours ; an egg in the centre of a chilled case, 18 hours (cooled from 97·2°F to 64·5°F); and an egg in the centre of a warm case, 20 hours (cooled from 92·0°F to 63·1°F).

There are two apparent explanations for the longer time required to cool eggs in the cases, etc. First, the size of the mass to be cooled was increased and the insulation subsequently placed around the eggs was greatly increased so that the rate of cooling was reduced. Second, the curves plotted in Figure 1 show a very definite lag in cooling in the case. This was evidently due to the fact that several hours were required for the colder air to reach the centre of the case.

Cooling eggs in a household refrigerator

The results of cooling eggs in a household refrigerator (30-38°) are shown in Figure 2 and Table II. It will be observed by comparing Figures 1 and 2 that the eggs cooled more rapidly in the refrigerator than in the egg room. The more rapid decrease in temperature of the eggs held in the refrigerator is, of course,

TABLE II

Effect of container on cooling eggs in a household refrigerator (30-38°F.)

Hours	Single egg	Wire basket	Galvanized pail	Warm case
0	97·7	101·0	98·0	101·9
1	55·0	96·5	..	..
2	35·5	85·9	90·5	98·2
3	..	74·0	..	..
4	..	63·5	73·5	95·9
5	..	56·0	..	..
6	..	53·2	62·0	91·0
8	..	43·1	..	82·0
10	..	39·0	53·0	74·0
12	..	36·0	..	..
13	..	..	42·2	..
14	..	..	..	63·0
18	..	..	..	54·0
20	..	..	36·5	50·9
23	..	..	..	47·8
27	..	..	..	44·6
31	..	..	..	40·3

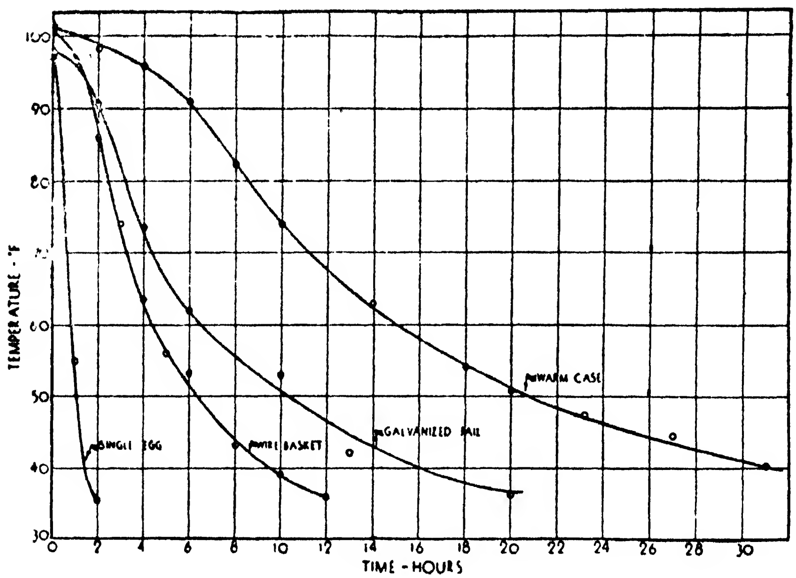

FIG. 2.—Effect of container on the rate of cooling in eggs held in a household refrigerator (30-38°F).

due to the greater difference between the temperature of the egg and the air surrounding it. Eggs exposed in a wire basket in a refrigerator cooled from 101°F to 63·5°F (a decrease of 37·5 degrees) in 4 hours, while eggs placed in a warm case cooled from 101·9°F to 63°F (a decrease of 38·9°) in 14 hours. Similar decreases in temperature occurred when eggs were held in the egg room at 50°F in a wire basket for 6 hours and in a case for 20 hours. The rate of cooling was approximately 50 per cent greater in the refrigerator than in the egg room.

EFFECT OF THE CIRCULATION OF AIR ON COOLING

Air movement in the egg room or refrigerator was an important factor influencing the rate of cooling. As an illustration, Table III and Figure 3 show the results obtained by cooling a wire basket full of eggs in an egg room by still air, and by air blown through the eggs with an electric fan. During the first hour the temperature of an egg in the centre of a wire basket exposed to circulating air (50°F) dropped from 95·2°F to 55·1°F or 40·1 degrees, while eggs in a similar position exposed to still air decreased only 4 degrees. Possibly producers and dealers would not want to use such a method for cooling eggs but some circulation of air in the cooling room seems desirable, particularly if the eggs are exposed in a wire basket or on a wire tray. An objection to the rapid circulation of air through

TABLE III

Effect of air circulation on cooling eggs in a wire basket (50°.)

Hour	Still air	Circulating air
	Temp. °*F*	*Temp.* °*F*
0	100	95·2
·25	..	81·8
·50	..	69·0
·75	..	60·8
1·00	96	55·1
1·25	..	53·1
1·50	..	51·5
1·75	..	50·8
2·00	87·2	50·2
3·00	79·1	..
4·00	72·7	..
5·00	67·5	..
6·00	63·6	..
7·00	60·5	..
8·00	58·5	..
9·00	57·2	..
10·00	56·5	..
11·00	55·2	..
12·00	54·7	..
13·00	54·2	..

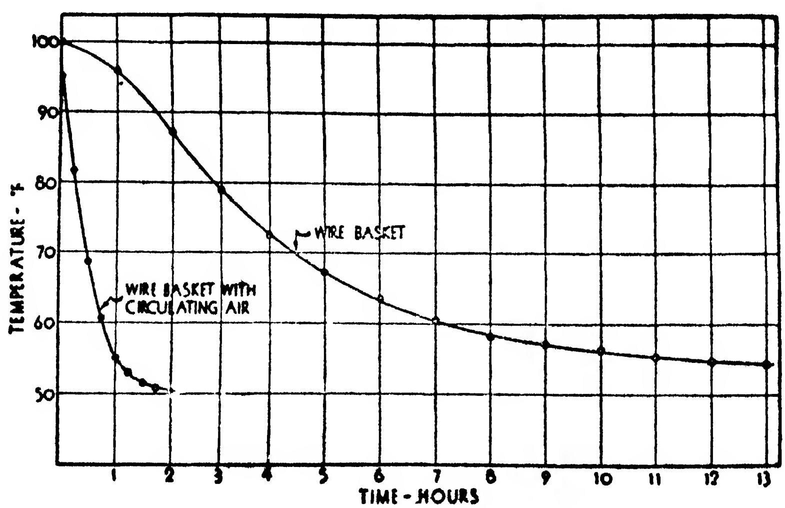

FIG. 3.—Effect of air circulation on the cooling of eggs held in a wire basket at 50°F.

eggs is, of course, that air movement ha ten evaporation and thereby increases the size of the air cell. The amount of evaporation would be influenced by the humidity of the air. A candling observation, and also weight determinations of

eggs cooled with the circulation of air (one hour) and without the circulation of air through a wire basket, showed that there was no significant difference in the eggs subjected to the two methods of cooling.

Rate of cooling in different parts of the egg

The rate of cooling in the centre of the egg and in the albumen just beneath the shell are shown in Figure 4 and Table IV. The outer albumen cools more rapidly than the centre of the egg but the egg is apparently a fairly good conductor of heat and therefore the difference in cooling was not great. Heat is radiated from the surface of the egg and conduction inside the egg tends to equalize differences in temperatures which may exist in different parts of eggs.

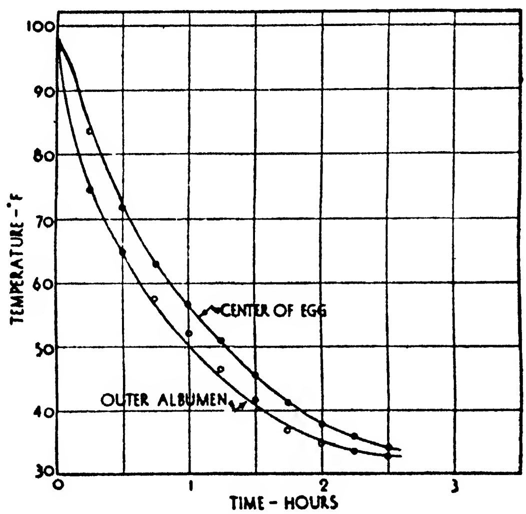

Fig. 4.—Rate of cooling in different parts of the eggs when held at 30-32°F.

Table IV

Rate of cooling in different parts of the egg when held at 30-32°F.

Hour	Centre of egg	Outer albumen
0	98·0	96·9
·25	83·5	74·5
·50	71·9	64·8
·75	62·5	57·2
1·00	56·2	51·9
1·25	50·8	46·5
1·50	45·3	41·5
1·75	41·0	36·9
2·00	37·5	34·5
2·25	35·8	33·5
2·50	34·0	32·8

THE USE OF COOLED CASES

A comparison of the results (*see* Table I and Figure 1) obtained in cooling eggs in a chilled case and a warm case indicates that it would be desirable to place eggs in cases which have been chilled instead of placing them in warm cases. It will be observed that during the first five hours the temperature of the eggs in the cooled case decreased 9·7 degrees while the eggs in the warm case decreased 5·9 degrees. The flats, fillers, and case when warm have considerable heat capacity which tends to reduce the rate of cooling. Figure 5 shows the difference in the rate of warming in eggs which were held in a chilled case and in a warm case. Eggs held in a warm case at 100°F for 14 hours increased 33·7 degrees while eggs held in a chilled case for the same length of time increased 25·3 degrees. It is

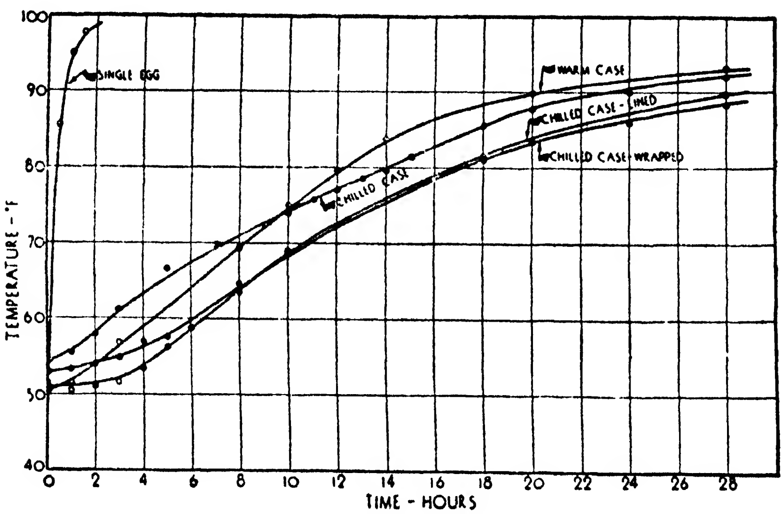

FIG. 5.—Effect of container on the warming of eggs held at 100F.

evident from these results that cooling the cases in hot weather before using them will reduce the temperature of the eggs more rapidly and will also help to prevent an increase of temperature in eggs which are exposed to high temperatures.

RATE OF WARMING EGGS

The problem of maintaining the proper temperature for eggs from production to consumption is not only a problem of reducing the temperature but of maintaining a low temperature in the egg after it has been cooled. The farmer or dealer may lower the temperature of the eggs to the desired level for holding but when they are transported to another point they are often subjected to high temperatures

TABLE V

Effect of container on warming eggs when held at 100°F.

Hour	Single egg	Chilled case	Chilled case lined	Chilled case wrapped	Warm case
0·	51·2	54·3	51·5	52·9	50·3
0·5	85·6	..	..	..	..
1·0	95·0	55·5	50·4	53·2	51·8
1·5	97·7	..	..	..	..
2·0	..	57·8	51.1	53·9	54·0
3.0	..	61·3	51.5	54·7	56·9
4·0	..	..	53.5	57·0	..
5·0	..	66·8	56.2	57·4	..
6·0	..	..	58.8	..	..
8·0	..	..	63.4	64·6	69·5
10·0	..	74·0	69.0	68·8	74·9
12·0	..	76·9	..	..	79·5
14·0	..	79·6	..	..	84·0
18·0	..	85·5	81.5	81·0	..
20·0	..	87·5	83.8	..	90·0
24·0	..	89·9	..	86·0	..
28·0	..	92·0	89.9	88·4	93·1

and therefore the eggs are again warmed. Table V and Figure 5 show the rate at which the temperature increased in eggs held under different conditions. The results show that when eggs which had been reduced to approximately 50°F were exposed to 100°F in a forced draft incubator the temperature in the centre of a single egg was raised to above 68°F in 10 minutes and that the temperature of eggs exposed in containers in the forced draft incubators for 10 hours had increased as follows; eggs in the centre of a warm case 24·6 degrees, chilled case 19·7 degrees, chilled and lined case 17·5 degrees, and a chilled case wrapped in a light blanket 15·9 degrees. These results show that it is highly desirable to case eggs which have been cooled and that the use of chilled cases, case liners or additional insulation will materially reduce the rate at which the temperature of the eggs increases.

RATE OF WARMING EGGS IN THE TOP AND MIDDLE FILLER OF THE CASE

That those eggs near the outside of a case should change temperature more rapidly than those in the centre of the case is to be expected. Table VI and Figure 6 show the differences which exist when eggs are warmed. The results show that during the early stages the eggs in the top layers warm more rapidly than those in the centre of the case, and the 68°F point is reached about 5 hours sooner. After 48 hours, however, there is no appreciable difference between the temperature of the eggs in the top and middle layers of the case. Similar differences would be expected to prevail when eggs are cooled. Therefore the readings we have reported for eggs in the centre of containers represent the slowest rate of cooling or warming in that particular container.

TABLE VI

Rate of warming of eggs in top and middle fillers of a case. Eggs held at 100°F

Hour	Top filler	Middle filler
0	51·9	51·5
1	53·0	50·4
2	56·8	51·1
3	58·8	51·5
4	63·2	53·5
5	65·8	56·2
6	69·0	58·8
8	73·7	63·4
10	78·5	69·0
17	87·5	81·0
20	89·4	83·8
26	92·7	89·2
28	93·2	89·9
30	93·5	90·7
34	95·0	92·9
42	96·0	94·0

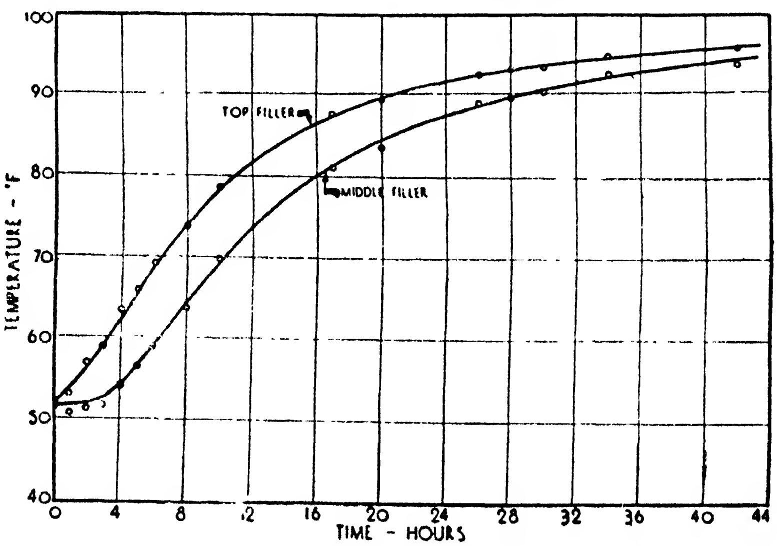

FIG. 6.—Rate of warming in the top and middle fillers of a case when held at 100°F.

GENERAL LAWS OF COOLING AS APPLIED TO EGGS

Newton's law of cooling states that the rate of loss of heat by a surface is proportional to the difference between its temperature and that of the surroundings. Since we may reason that the principal loss of heat from an egg is by radiation from its surface, we may express for all practical purposes this law for the cooling of an egg as

$$D=K\ (Te - Ts)$$

where D is the decrease in temperature during any time interval, Te is the temperature of the egg and Ts is the temperature of the surroundings at the beginning of a time interval, and K is a constant to be determined for the material (egg) studied. It is evident that after the container and egg have been held at a relatively low temperature long enough for the maximum rate of cooling to be reached at the point (centre of the egg) where the temperature is being taken, the temperature change should be uniform and therefore the above formula would give an equation for approximating the temperature change in the egg during any period of time in which a temperature difference existed. Calculating the values of K under the conditions investigated gives the values listed in Table VII.

TABLE VII

Relative rates of cooling and warming eggs

Container, temperature, etc.	Value of K for time intervals of one hour
A. Refrigerator (30-38°)—	
1. Single egg on wire tray	·650
2. Eggs in a wire basket	·210
3. Eggs in a wire basket with circulating air	·860
4. Eggs in a pre-heated bucket	·115
5. Eggs in a pre-heated case	·075
B. Egg room (50°F)—	
1. Single egg on wire tray	·750
2. Three layers on wire tray	·280
3. Eggs in a wire basket	·202
4. Eggs in a wire basket with circulating air	·910
5. Eggs in a pre-heated bucket	·130
6. Eggs in a case	·060
C. Forced draft incubator (100°F)—	
1. Single egg on a wire tray	·900
2. Eggs in a chilled case	·065
3. Eggs in a warm case	·085
4. Eggs in a chilled case lined with case liner	·055
5. Eggs in a chilled case lined with two thicknesses of newspaper	·050
6. Eggs in a chilled case wrapped in a blanket	·052
7. Eggs in a wire basket	·370

It should be noted that for cooling in cases or other containers where some time is required for the cold air to reach the centre of the container, the values of K only apply to that portion of the curve formed after the point of maximum cooling has been reached. It is also true that theoretical curves calculated for cooling in single eggs do not fit the readings made during the first few minutes because some time is required for the centre of the egg to be affected.

An accurate determination of changes in temperature in eggs during any time interval must consider all the factors influencing the loss of heat from an egg if these determinations are to have any general applications. These factors are size,

colour, shape, density, specific heat, emissivity of heat, air movement at the surface of the egg, humidity of the atmosphere, and the difference in temperature between the egg and the surrounding air. In this investigation an attempt was made to control as many of these factors as possible by using eggs of near the same size (56 grams), color (white), shape (standard), density and specific heat (fresh eggs), and air movement and humidity (same room, refrigerator or incubator). With these factors fairly well standardized the temperature at approximately the centre of the egg and the temperature of the surrounding air was determined at regular intervals. The values determined appear to conform fairly well to mathematical curves and therefore it is believed that under similar conditions they have general applications.

Suggested practices

The results of these investigations justify the following recommendations:

Eggs should be gathered often during hot weather and placed in containers where they are exposed directly to cool air. Eggs held on a wire tray or in a wire basket will cool more rapidly than eggs held in a bucket or case. They should not be placed in cases until the temperature of the eggs has been reduced by exposing them to low temperatures. Germ development continues for several hours when warm eggs are placed in cases.

The use of cool cases instead of warm cases will help to keep eggs cool. The flat, fillers, and cases carry considerable heat which should be removed by cooling them before the eggs are cased.

Circulating air in the egg room will speed up cooling very greatly, especially if the eggs are held in a wire basket or on a wire tray. If the air is dry, the circulation of air will increase evaporation so that the benefits from rapid cooling may be lost by the damage due to increased size of the air cell. Where facilities are available for increasing air circulation the practice would be advisable, particularly if a relatively high humidity can be maintained.

The use of case liners or other insulation tends to keep eggs cool when the eggs in their containers are exposed to high temperatures. When eggs are cooled on the farm or in the dealer's plant, and later exposed to high temperatures in transit, they should be protected by shade and insulation. The producer will find that wrapping a case in a piece of canvas or blanket and keeping the sun from shining on the case will help to keep the eggs cool while they are being taken to market.

Plate XI, fig. 1 shows a wire tray for cooling eggs, a wire basket for gathering eggs, the regular 30 dozen case for holding and transporting eggs and a front view of the Missouri Egg Cooler.* Eggs should be gathered in a wire basket, and held in a cool place in the basket, or on wire trays, over night to permit all heat

* Fully described in Agricultural Extension Service Circular 299.

to escape from the eggs. When cooled the eggs should be cased and held in a cool place until taken to market.

The room or cooler used should have a relatively high humidity because a dry atmosphere surrounding the eggs will cause rapid evaporation and therefore enlarge air cells in the eggs. The humidity may be kept high by keeping the floor damp and by hanging pieces of wet burlap in the room. Evaporation of moisture from the floor or the burlap will tend to reduce the temperature of the room or cooler.

Where adequate facilities are not available for holding eggs below 68°F during the summer months producers should provide these facilities by building an inexpensive egg cooler. Plans for such a cooler may be obtained from the county extension agent or from the department of poultry husbandry, College of Agriculture, Columbia, Missouri.

Acknowledgments

The author desires to acknowledge the valuable services of John Clark, a graduate student in the physics department, who constructed the thermo-couple; Dr. R. T. Dufford, physics department, who made valuable suggestions; Professor H. L. Kempster, poultry department, for helpful suggestions and cooperation; and Charles Williams, a senior in the College of Agriculture who recorded most of the readings.

Summary

Eggs must be held at relatively low temperatures to preserve their quality. Recent investigations at the Missouri Agricultural Experiment Station show the temperature changes which occur when eggs are held in various containers and at different temperatures.

Eggs in which the temperature varied from 92°F to 102°F when held in an egg room at 50°F and cooled to below 68°F required the following time: single egg in one hour (39·9°F), an egg in the centre of three layers of eggs on a wire tray, 3 hours; an egg in the centre of a wire basket, 5 hours (32·5°F); an egg in the centre of a galvanized pail, 10 hours (32·9°F); an egg in the centre of a chilled case, 15·5 hours (29·2°F); and an egg in the centre of a warm case in 15 hours (24·0°F).

Eggs held in a household refrigerator in containers similar to those used in cooling eggs in an egg room (50°F) cooled more rapidly than when they were cooled in the egg room because the difference in temperature between the egg and the surrounding air was greater.

Circulation of air in the refrigerator or egg room increased the rate of cooling particularly when the eggs were held on a wire tray or in a wire basket.

Eggs placed in cases which had been chilled cooled more rapidly than those placed in warm cases.

The general laws of cooling apply to the cooling of eggs and certain values can be used for estimating the decrease in temperature of eggs held in different containers and at various temperatures. There are many factors influencing the rate of heat flow from an egg and therefore values determined under one set of conditions will not apply to cooling under other conditions.

The problem of preventing an increase in temperature is as important as the problem of cooling eggs. The use of chilled cases, case liners, and insulation for the cases will reduce the rate at which the temperature of the eggs increases when the eggs in their containers are exposed to high temperatures.

ABSTRACTS

Variation in the characters of cotton in relation to the position of bolls on the plant. K. R. SEN AND MOHAMMAD AFZAL. (*Ind. J. Agric. Sci.*, 7, 35).

IN this paper the effect of the position of the bolls along a branch as well as that of the position of the boll-bearing branches on the plant have been studied with respect to (*i*) seed and lint indices, (*ii*) mean fibre-length, (*iii*) mean fibre-mass per unit length, and (*iv*) mean proportion of mature and immature fibres. The experiments were conducted in such a way that the effect of climate which supervened the effect of the position of bolls on the plant, could also be indicated.

The material consisted of the well opened labelled bolls of the Punjab-American strain (45F) grown at the Cotton Research Station, Lyallpur, in 1933. In course of the investigation the bolls opening within the successive 5-day intervals were considered to have opened on the same day.

The fibre test results were analysed statistically. It was concluded that fibre properties do not depend on the position of the boll on the plant. The apparent fluctuations can only, therefore, be due to any irregular fluctuations of biological origin coexistent with fluctuations due to climate and water conditions. This conclusion has been extensively discussed with reference to physiological facts and climatic factors. (*Authors' abstract*).

Studies in Indian barleys. 4. The inheritance of some anatomical characters responsible for lodging and some ear-head characters in an interspecific cross between two Pusa barleys. R. D. BOSE; M. A. AZIZ AND M. P. BHATNAGAR. (*Ind. J. Agric. Sci.*, 7, 48).

A CROSS between two Pusa barleys, Type 21 × Type 1, was studied genetically for the inheritance of (1) some anatomical characters in relation to lodging and (2) some ear-head characters. Type 21 barley possesses strong straw while Type 1 has rather weak straw. In the F_2 two intermediate phenotypes, one approaching the lodging, and the other the non-lodging parent, were obtained in addition to the parental phenotypes and the segregation was found to depend on a 9 : 3 : 3 : 1 basis, with the non-lodging character behaving as the double recessive and the lodging character as the dominant. Radial width of the schlerenchymatous band, and the diameter of the tangential as well as of the radial axes of the vascular bundles all showed segregation due to multiple genes with possibly the same set of factors operating. No correlation was found to exist between these anatomical phenotypes and (1) fertility of the ear-head; (2) nature of outer glumes; (3) length of ear-head; (4) tillering capacity of plants; and (5) maturity of the plants.

Type 21 is a 6-rowed barley with narrow outer glumes whereas Type 1 is 2-rowed and differs from all other Pusa types in possessing broad outer glumes. The F_1 plants were intermediate in nature for fertility and had narrow outer glumes. The inheritance of fertility of the lateral florets and the awns on the inner glumes of these florets depend upon the interaction of the same genetic factors and these two characters as well as the outer glumes have been found to be inherited on a monogenic basis. Linkage is found to exist between fertility and the nature of outer glumes. No linkage has been observed between fertility or the nature of outer glumes and (1) maturity as measured by the number of days taken by individual plants to head out, (2) length of ear-heads and (3) internode length. (*Authors' abstract*).

Studies in the water-relations of rice. I. Effect of watering on the rate of growth and yield of four varieties of rice. P. K. SEN. (*Ind. J. Agric. Sci.*, 7, 89).

WATER relations of three varieties of early-ripening and one variety of late-ripening rice were studied under varying water conditions in the field.

Three inches depth of water, wet but not flooded, and cracked condition of the field were used as three different water conditions ; their effects were studied singly and in combination with three different stages of growth of the crop. Second and third weeks, fourth and fifth weeks and sixth and seventh weeks after transplanting, represented the three different stages. In all eighteen treatments were employed.

The effect of partial submergence on the growth of the plant was also studied in pot culture in cemented tanks.

Standing water suppresses tillering. Height of the plant increases with water. Water shows an optimum effect on the growth of the plant varying with the variety.

Flooding the field after transplanting for about three weeks in the early ripening and somewhat longer in late ripening varieties followed by subsequent draining is beneficial. Flooding in the earlier stages seems not to affect the plant directly. It is suggested that it produces and maintains a certain texture and temperature condition of the soil suitable for young seedlings to establish themselves. During later stages draining is necessary for aeration. (*Author's abstract*).

Inheritance of sheathed ear in rice. R. L. SETHI ; B. L. SETHI AND T. R. MEHTA. (*Ind. J. Agri. Sci.*, 7, 134).

THIS paper deals with a study of the inheritance of a protective device in rice which determines its immunity to the attacks of the rice fly, *Leptocorisa varicornis*. The protective device is an expansion of the leaf sheath which keeps the ear covered throughout the life of the plant thus preventing the fly from gaining an access to the developing grains which would otherwise be eaten away. The device, styled as 'ear-sheath' in the paper, is present only in a group of coarse, poor-yielding rices called *Sathi*, but absent from all the heavy yielding and good quality rices. Crosses made between one

of the *Sathi* types and some of the latter in 1929 have been studied and the inheritance of the 'ear-sheath' described. The inheritance of this character in rice is studied for the first time in India. The Mendelian ratios obtained were complicated and confusing, but they could be satisfactorily explained on a trihybrid basis. True breeding promising hybrids have been obtained in the F_6 generation and some of them appear to be of great economic significance. (*Authors' abstract*).

Preliminary experiments on the mass production of Trichogramma parasites for control against sugarcane borers in Mysore. T. V. SUBRAMANIAM. (*Ind. J. Agric. Sci.*, 7, 149).

THE method successfully employed in Mysore in the rearing of the egg-parasites, *Trichogramma minutum* Riley, of the sugarcane borers is described.

The technique of parasite multiplication and the breeding of the flour moth *Corcyra cephalonica* Staint for egg production in the laboratory is described in detail.

A single wasp parasites on an average 64·3 eggs out of which 69·07 per cent hatch and wasps emerge therefrom. An average of 74·7 per cent of these wasps are found to be females and the rest males. The developmental period of the wasps in the host eggs varies from seven to eleven days according to the temperature variations of the hot and cold months of the year.

After being parasitised in tubes, the egg cards are kept in cold storage on the fifth day upto a period of one month.

Depending for moth supply solely on flour mills and the two moth breeding cupboards in the laboratory, it was possible to obtain an average (nine months average) of 12,000 eggs per week for parasitisation by the wasps in the year 1934.

Some difficulties encountered during the breeding of the flour moth and parasite are mentioned.

Encouraging results have been obtained from preliminary colonization trials with the laboratory reared parasites. Weekly releases of about 5,000 parasites continued for nine weeks in an acre of young borer infested cane area in October 1933, raised the parasitisation of the eggs of the borer *Argyria* from 10 per cent to 79·3 per cent and 15 per cent to 92·4 per cent in four and ten weeks respectively from the commencement of colonization. Small-scale parasite releases done twice in May and September 1934 have given results more or less confirming those of the previous year. (*Author's abstract*).

Importance of the study of insect ecology in applied entomology. TASKHIR AHMAD. (*Ind. J. Agric. Sci.*, 7, 156).

THE study of insect ecology or the behaviour of insects in relation to their environment is very important in reference to the forecasts of insect pests and to the devising of control measures. The determination of the influence of well-controlled individual

factors of environment, *e.g.*, temperature, humidity, light, food, parasites and competitors, on the rate of multiplication and development of a species is an essential preliminary for evaluating the combined effect of the whole environment.

Under different conditions of temperature and moisture the effective reproductive potential of *Ephestia kuhniella* varies from 3·78 at 30° C and 14 mm. saturation deficiency to 78·3 at 23° C and 3 mm. saturation deficiency. The latter conditions thus represent the most optimum environment for the multiplication of this insect.

The rate of development is chiefly controlled by temperature though humidity also plays a significant part. From the rate of development curves for the eggs of *Locusta migratoria* and pupae of *Muscina stabulans* and *Calliphora erythrocephala* at different temperatures it is noticed that respective thresholds of development are 17° 9° and 6° centigrade. This reveals the differences in the nature of habitats of these species. The first is a tropical insect while the other two, particularly the blow fly, are inhabitants of cooler regions. Studies at constant temperatures alone are however not sufficient to indicate the full influence of the environmental temperature which is fluctuating in nature. Exposures to low temperature may accelerate development in some insects like the blow fly which is adapted to such exposures in nature but may produce a little or no acceleration in others like *Locusta migratoria* and *Muscina stabulans*.

Each insect species has an optimum requirement of moisture as of temperature. Thus, whereas the eggs of *L. migratoria* require a saturated atmosphere for development, the pupae of blow fly develop best in 3 mm. saturation deficiency and those of Muscina fly in 9 mm. saturation deficiency.

The relationships of insect hosts to their parasites though very complicated can be understood by an intensive ecological study of each. Thus the reproductive potential of *Ephestia kuhniella* is markedly affected by high temperature and high saturation deficiency but that of its endoparasite *Nemeritis canascens* is hardly or little affected. The threshold of development of the host lies at 8°-10° C, that of the parasite at 10°-15° C. While the host can continue its development at the latter temperatures the parasite cannot do so. High temperatures increase the rate of development of the parasite more than that of the host. Low temperatures on the whole therefore favour the host, while the high temperatures favour the parasite. (*Author's abstract*).

Kumri—Second progress report. P. G. MALKANI. (*Ind. J. Vety. Sci. and Anim. Hus.*, 7, 1).

SERIES of clinical observations on animals affected with Kumri have shown that majority of them present a uniform symptom-complex; and therefore, the disease is regarded as a definite morbid entity. The thick sedimenting urine rich in phosphates and cylindroids, is quite constant a feature to serve as an aid in diagnosis. Schistosomes have been found to be present in numbers in the liver in every case of Kumri and the blood has also shown a slight, but distinct, eocinophilia, which, while common to many helminthic infestations and dermatic disturbances, is a notable feature in schistosomiasis. (*Author's abstract*).

NOTES

FOOT-AND-MOUTH DISEASE

The following are extracts from the Annual Administration Report of the Army Veterinary Service in India for 1935-36 :—

" Outbreaks were numerous involving 1,389 admissions with 20 deaths, against 1,247 admissions with 15 deaths last year. The vast majority of animals affected belonged to the Military Farms Department.

The fatal cases occurred chiefly among cross-bred stock in which the disease runs a more virulent course.

A simple and practical line of treatment originated by Lieutenant-Colonel V. C. Leckie, D.S.O., and Major G. F. Steevenson, which has so far given excellent results, was instituted this year as routine. Affected cattle are made to stand in a foot-bath containing 2 per cent copper sulphate, twice daily. Incontacts and unaffected are walked through a foot-bath containing 2 per cent cresol, four times daily, on the way to water. Fresh chlorinated lime 90 grains per 100 gallons is added to the drinking water, which although it smells strongly of chlorine, is readily consumed.

Not only has this treatment considerable curative effect but it also assists in curtailing spread of the disease Despite the high degree of infectivity, in one outbreak out of 300 cattle on the premises only 11 developed clinical symptoms, whilst on another occasion only 11 out of 183 cattle were visibly affected.

It is difficult to avoid outbreaks of Foot-and-Mouth Disease on Farms owing to the propinquity of affected civilian cattle, but a good deal can be accomplished by the adoption of appropriate measures designed to lessen contact, direct or indirect, between military and civilian animals."

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PLANNED ECONOMY AND THE INTERNATIONAL YEAR-BOOK OF AGRICULTURAL LEGISLATION

The following communication has been received from the Press Bureau of the International Institute of Agriculture, Villa Umberto, Rome :—

At a time when under the pressure of circumstances and later of deliberate purpose, State intervention in the economic field is being manifested to a constantly increasing degree, publications containing clear and recent information on the enactments adopted regarding questions of this order in the different

countries, acquire a quite special importance. It is greatly to the interest of each Government to be in a position to obtain a thorough and timely knowledge of the solution proposed by the Government of another country of some particular problem of the kind that frequently arises also in its own land to the end that it may itself be induced to feel the need of discovering solutions that may be still more felicitous.

In the picture of the legislation of the year 1935 measures on the trade in farm products have taken first place. The tendency to organize the marketing of farm products and to concentrate the sale in the hands of public bodies or of bodies directly controlled by the State has been exhibited to a more marked degree than in previous years. This concentration, which is intended in the interest of the public to withdraw, economic activities of this order from the inevitable disturbances originating in competition, has resulted in establishing, in certain countries and in relation to certain products, a form of equality among producers as regards the risks of finding a market for their harvests and also as regards price fluctuations.

The International Year-book of Agricultural Legislation, prepared and published for many years past by the International Institute of Agriculture of Rome, contains in its latest issue published in August 1936, a detailed statement regarding these measures and the trend of Agricultural Legislation in 1935. The Year-book is a stout volume consisting of some 900 pages, provided with two tables of contents, thus greatly simplifying the work of consultation and reference, statistics of agriculture and trade, financial and customs legislation, plant and livestock production, legislation dealing with land tenure and agricultural training, plant diseases and pests, agricultural co-operation, agricultural credit and insurance, rural ownership and internal settlement, legislation on the relations between capital and labour in agriculture, legislation dealing with rural hygiene and the policing of the country side—all these give their titles to the various chapters in which are grouped the laws, orders and regulations adopted on these subjects in all countries of the world. The most important provisions are reproduced in full, for the others the title only is given. The volume further contains a very complete introduction, supplying a review of the general trend of agriculture in 1935.

The International Institute of Agriculture which has as its main function the collection and publication of agricultural intelligence for the whole world, thus puts at the disposal of statesmen, experts and scientists an excellent fount of information and of material for reference forming a very happy complement of the series of periodical publications issued by this Institute, all of which have as their purpose the service of world agriculture.

STATISTICS OF THE PRODUCTION OF CERTAIN SELECTED INDUSTRIES IN INDIA

THE following statistics are reproduced from the "Monthly Statistics of the Production of Certain Selected Industries of India", Nos. 1 and 2, April and May, 1936, issued by the Director-General of Commercial Intelligence and Statistics, Calcutta :—

April and May 1936

Detailed statement of the quantity and description of jute manufactures produced in India.

Description		Month of April		Month of May		Two months, April and May	
		1935	1936	1935	1936	1935	1936
I.—Twist and yarn	tons	3,661	3,966	3,817	3,979	7,478	7,945
II.—Manufactures—							
Canvas	tons	141	233	146	227	287	460
	yds.	253,443	475,608	271,204	400,740	524,647	876,348
Gunny bags— (a) Hessian	tons	4,789	7,341	3,962	5,437	8,751	12,778
	No	10,806,280	16,136,079	7,413,290	11,057,830	18,219,570	27,193,909
(b) Sacking	tons	48,641	50,685	49,178	49,282	97,819	99,967
	No.	46,251,244	47,538,803	48,086,202	45,838,033	94,337,446	93,376,836
Gunny cloth—							
(a) Hessian	tons	24,469	30,841	26,619	31,895	51,088	62,736
	yds.	94,459,052	120,942,141	102,336,606	123,385,299	196,795,658	244,327,440
(b) Sacking	tons	2,393	1,894	2,465	2,091	4,858	3,985
	yds.	5,092,115	4,20[illegible],236	4,912,838	4,711,287	10,004,953	8,915,523
Other manufactures including rope and twine	tons	266	364	263	375	529	739
Total	tons	84,360	95,324	86,450*	93,286	170,810*	188,610
	yds.	99,804,610	125,621,985	107,520,648*	128,497,326	207,325,258*	254,119,311
	No.	57,057,524	63,674,882	55,499,492	56,895,863	112,557,016	120,570,745

Detailed statement of the quantity and description of sulphuric acid produced in India

Description	Month of April		Month of May		Two months, April and May	
	1935	1936	1935	1936	1935	1936
	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.
Ordinary or non-fuming sulphuric acid.	55,330	44,180	39,118*	19,824	94,448*	64,004
Fuming sulphuric acid	10	...	...	...	10	...
Total	55,340	44,180	39,118*	19,824	94,458*	64,004

* Revised.

Detailed statement of the quantity and description of sulphate of ammonia produced in India

Description	Month of April		Month of May		Two months, April and May	
	1935	1936	1935	1936	1935	1936
	Tons	Tons	Tons	Tons	Tons	Tons
Neutral	1,411*	1,447	1,426*	1,231	2,837*	2,678
Acid	19	22	21	160	40	182

*Revised.

Detailed statement of the quantity and description of sugar produced in India

[In bazaar maunds of 82 2/7 lbs. each]

Description	Month of April		Month of May		Two months, April and May	
	1935	1936	1935	1936	1935	1936
	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.
(i) Khandsari sugar *	(a) 9,195	10,412	(a) 6,275	6,322	(a) 15,470	16,734
(ii) All other sugar except Palmyra sugar.	(a) 863,516	2,226,990	(a) 239,074	560,627	(a) 1,102,590	2,787,617
(iii) Palmyra sugar	7,335	8,079	3,771	7,393	11,106	15,472
Total	(a) 880,046	2,245,481	(a) 249,120	574,342	(a) 1,129,166	2,819,823

* Figures relate to excised issues only. (a) Revised.

Detailed statement of the quantity and description of wheat flour milled in India

[In bazaar maunds of 82 2/15 lbs. each].

Description	Month of April		Month of May		Two months, April and May	
	1935	1936	1935	1936	1935	1936
	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.
Flour	456,418	417,330	465,849	414,208	922,262	831,538
Atta—						
High grade	267,578	267,004	200,644	233,568	468,222	500,572
Low grade	112,175	107,550	177,113	105,704	289,288	213,254
Bran	209,717	196,157	219,134	192,213	428,851	388,370
Soojee	34,959	33,843	41,000	33,192	75,959	67,035
Others	5,037	6,498	7,045	6,016	12,082	12,514
Total	1,085,879*	1,028,382	1,110,785*	984,901	2,196,664*	2,013,283

* Revised.

PLANT QUARANTINE AND OTHER OFFICIAL ANNOUNCEMENTS

BRITISH INDIA

Notification No. F. 116-34-A., dated the 11th November 1936, issued by the Government of India, in the Department of Education, Health and Lands

In continuation of this Department notification No. 360, dated the 29th February 1924, as subsequently amended, it is notified for general information that the Chief Agricultural Officer in Sind is empowered to inspect and grant certificates in respect of plants intended for export to the United Kingdom and to other countries the Governments of which require a certificate of freedom from disease to accompany consignments of plants. Arrangements have been made at the Fruit Farm, Mirpurkhas, Sind, for inspection and certification, but 10 days notice in advance has to be given by the consignors in each case.

(Sd.) M. S. A. HYDARI,
Joint Secretary.

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GREAT BRITAIN AND NORTHERN IRELAND

Orders as at 1st October 1936, made under the Destructive Insects and Pests Acts, 1877 to 1927, affecting the Importation into Great Britain and Northern Ireland of Agricultural and Horticultural Produce, and Summary of Provisions thereunder

ORDERS

1. The Importation of Elm Trees and Conifers (Prohibition) Orders of 1933 and 1935.
2. The Importation of Elm Trees and Conifers (Prohibition) (Scotland) Orders of 1933 and 1935.
3. The Importation of Elm Trees and Conifers (Prohibition) (Northern Ireland) Orders of 1933 and 1935.
4. The Importation of Plants Orders of 1933 to 1936.
5. The Importation of Plants (Scotland) of 1933 to 1936.
6. The Importation of Plants (Northern Ireland) 1936.
7. The Importation of Raw Cherries Order of 1936.
8. The Importation of Raw Cherries (Scotland) of 1936.

SUMMARY OF PROVISIONS

(So far as importation from countries outside the British Isles is concerned)

(a) *Articles absolutely prohibited*

Articles prohibited from importation	Countries from which importation prohibited
1. All elm trees (*Ulmus*) 2. Certain conifers, namely the following genera of the order *Pinaceae* :— *Abies* *Larix* *Picea* *Pinus* *Pseudotsuga* *Sequoia* *Thuja* *Tsuga*	All countries outside the British Isles. (Licences may be issued for the landing of plants for instructional scientific and similar purposes.)
3. Living plants of sugar beet or mangold (*Beta vulgaris* Linn).	All countries outside the British Isles. (Landing may be effected only under licence.)
4. Potatoes	The U. S. A., the Dominion of Canada and European France. (Transhipment is also prohibited except under licence.)

(b) *Articles conditionally permitted entry*

(This summary is not applicable to produce from England and Wales, Scotland, Northern Ireland, the Irish Free State, the Isle of Man or the Channel Islands)

Articles conditionally prohibited from importation	Conditions of entry	Countries from which importation restricted
1. Potatoes . .	Must be accompanied by two copies of a certificate of an authorised officer of the Phytopathological Service of the country of origin to the effect that on examination the consignment was found to be healthy and that wart disease has not occurred at any time on the land on which the potatoes were grown nor within 2 kilometres thereof.	All countries other than those to which total prohibition applies [*See* (*a*) 4].
	Must be accompanied by certificates as above including a statement to the effect that the Colorado Beetle does not exist and has not been known to exist within 50 kilometres of the place where the potatoes were grown.	Belgium.

Articles conditionally prohibited from importation	Conditions of entry	Countries from which importation restricted
2. All living plants and parts thereof (except seeds) for planting.	Must be accompanied by certificates as for potatoes, without wart disease clause, but including a statement that the consignment does not contain any plant of any of the genera prohibited by the Importation of Elm Trees and Conifers (Prohibition) Order of 1933 and the Importation of Plants (Amendment) Order of 1935 [*See* (*a*) 1, 2, and 3.]	All countries.
	Must be accompanied by certificates as above including a statement to the effect that the plants were grown at a place more than 50 kilometres distant from the nearest point of the nearest 'zone de protection' established by the French Authorities against the Colorado Beetle. (This additional certificate is not required for flower-bulbs, including corns, tubers and rhizomes).	European France.
	Must be accompanied by certificates as above including a Colorado Beetle statement as in the case of potatoes from Belgium. (This additional certificate is not required for flower bulbs, including corns tubers and rhizomes).	Belgium.
3. Raw vegetables (not including cucumbers or mushrooms, for which no certificates are required.)	Between 8th April and 14th October, must be accompanied by a certificate of origin vise by a competent authority in the country of origin.	All countries other than European France and Belgium.
	Between 8th April and 14th October, must be accompanied by a Colorado Beetle declaration as in the case of plants from France. (Certain Departments in the north of France are exempt from this condition between 8th and 21st April, but a certificate of Departmental origin must be produced with each consignment).	European France.
	Between 21st April and 14th October, must be accompanied by a Colorado Beetle declaration as in the case of potatoes and plants from Belgium.	Belgium.

Articles conditionally prohibited from importation	Conditions of entry	Countries from which importation restricted
4. Cider apples .	Between 8th April and 14th October, must be accompanied by certificate of origin vise by a competent authority in the country of origin.	European countries other than France and Belgium.
	Between 8th April and 14th October, must be accompanied by a Colorado Beetle declaration as in the case of plants and raw vegetables from France.	European France.
	Between 21st April and 14th October, must be accompanied by a Colorado Beetle declaration as in the case of potatoes, plants and raw vegetables from Belgium.	Belgium.
5. Raw apples .	Between 7th July and 15th November, must be accompanied by a certificate signed by an authorised Inspector of the Federal Department of Agriculture that they are one of four specified grades.	The U. S. A.
6. Raw cherries* .	After 27th May, must be accompanied by a certificate of origin vise by a local authority in the country of origin.	All European countries other than Spain, France, Italy and Germany.
	After 27th May prohibited	Spain.
	After 27th May, must be accompanied by a certificate to the effect that they were grown in a certain specified zone.	France.

**Note.*—The restrictions under this heading are liable to variations from year to year, and are not applicable to entries into Northern Ireland. The particulars given above are those in the Order for the 1936 season, except as regards Italy for which the details are those which were in force in 1935.

Ministry of Agriculture and Fisheries,
Department of Agriculture for Scotland,
Ministry of Agriculture for Northern Ireland.

October, 1936.

Articles conditionally prohibited from importation	Conditions of entry	Countries from which importation restricted
	Between 28th May and 12th June inclusive, must be accompanied by a certificate of origin vise by a local authority. Between 13th June and 23rd June inclusive, must be accompanied by a certificate to the effect that they were grown within the Region of Emilia. After 23rd June prohibited.	Italy.
	Between 28th May and 26th June inclusive, must be accompanied by a certificate of origin vise by a local authority. After 26th June, must be accompanied by a certificate to the effect that they were not grown south of latitude 53°N or in East Prussia.	Germany.

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NYASALAND PROTECTORATE

THE PLANT PESTS AND DISEASES ORDINANCE

(CAP. 64 OF THE LAWS)

Proclamation No. 10 of 1936

WHEREAS by section 9 of the Plant Pests and Diseases Ordinance it is provided that the Governor in Council may by proclamation prohibit or restrict the introduction of any plant or seed from any specified country or place.

Now therefore in exercise of the powers vested in me as aforesaid and with the advice of the Executive Council, I Harold Baxter Kittermaster, Knight Commander of the Most Distinguished Order of Saint Michael and Saint George, Knight Commander of the Most Excellent Order of the British Empire, Governor and Commander-in-Chief of the Nyasaland Protectorate do hereby proclaim and declare that the importation of any rose plant from Australia, Canada or the United States of America shall be permitted only on condition that the consignment be certified to the satisfaction of the Director of Agriculture by a duly authorised official of the country whence the same was exported to be free from any virus disease of roses.

Given under the hand of the Governor and the Public Seal of the Protectorate at Zomba this twelfth day of August, 1936.

By Command of His Excellency the Governor,

(Sd.) A. G. O. HODGSON,

Acting Chief Secretary to the Government.

Proclamation No. 11 of 1936

WHEREAS by section 9 of the Plant Pests and Diseases Ordinance it is provided that the Governor in Council may by Proclamation prohibit or restrict the introduction of any plant or seed from any specified country or place.

Now therefore in exercise of the powers vested in me as aforesaid and with the advice of the Executive Council, I Harold Baxter Kittermaster, Knight Commander of the Most Distinguished Order of Saint Michael and Saint George, Knight Commander of the Most Excellent Order of the British Empire, Governor and Commander-in-Chief of the Nyasaland Protectorate, do hereby proclaim and declare that the introduction into the Protectorate from any countries other than the Union of South Africa, Southern Rhodesia, Northern Rhodesia and the Belgian Congo of the following plants is prohibited :—

Eucalyptus, acacia, coniferous, oak (Quercus) and plane (Platanus) plants or any portion thereof, except seed and manufactured products of these plants.

Live peach stones ;

Fresh stone fruits ;

Fresh citrus fruits and dried citrus peel, excluding candied citrus peel ;

Elm seeds and plants, including all species of *Ulmus ;*

Chestnut seeds or plants, including all species of *Castanea ;*

Any plant packed in soil other than special rooting compost ;

Apples, pears, quinces and loquats ;

Unmanufactured broom corn unless the crowns are completely cut away or otherwise crushed to shreds.

Given under the hand of the Governor and the Public Seal of the Protectorate at Zomba this fifteenth day of August, 1936.

By Command of His Excellency the Governor,

(Sd.) A. G. O. HODGSON,

Acting Chief Secretary to the Government.

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CZECHOSLOVAKIA

PLANT QUARANTINE IMPORT RESTRICTIONS, REPUBLIC OF CZECHOSLOVAKIA

B. E. P. Q.-366, Supplement No. 3, March 2, 1936

As a precaution against the introduction of wart disease [*Synchytrium endobioticum* (Schilb.) Perc.] the importation of potatoes into Czechoslovakia during 1935 is prohibited from countries other than Italy, Hungary, Spain, and Yugoslavia.

Import permits may be granted in exceptional cases, for consignments proceeding from the Netherlands, Canada, Germany, Poland, and Austria. (Ministerial Notification of Apr. 1, 1935).

San Jose scale prohibition extended

On the basis of precautionary measures against the introduction of San Jose scale (*Aspidiotus perniciosus* Comst.), the order of July 27, 1935, extends the prohibition against the importation of living plants, stocks, cuttings, and scions, as well as other cut plant parts with which the said goods have come in direct contact, and finally of barrels, cases, sacks, and other containers that have served to pack or hold such goods, to those proceeding from India, Portugal, Spain, and Yugoslavia, inasmuch as San Jose scale has invaded those countries.

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CHILE

PLANT QUARANTINE IMPORT RESTRICTIONS OF THE REPUBLIC OF CHILE

B. P. Q.-348, Supplement No. 4, dated September 1, 1936, of the United States Department of Agriculture, Bureau of Entomology and Plant Quarantine, Washington, D. C.

Regulations to prevent the introduction of cottonseed pests

DECREE No. 671, October 30, 1933 (See Supplement No. 2 to B.P.Q.-348), was superseded by decree No. 1031, September 30, 1935, which in turn, has been superseded by decree No. 226, March 31, 1936, a translation of which follows :

Fumigation required to prevent introduction of pink bollworm

Article 1. -Cottonseed imported into Chile for the production of oil, unginned cotton, and the containers thereof, proceeding from regions where the pink bollworm (*Pectinophora gossypiella* Saund.) exists shall be fumigated or treated by heat before embarkation, in such a manner as to destroy all insects contained in the shipment.

The phytosanitary authority of the exporting country shall certify to the fumigation in the phytosanitary certificate that must accompany the shipment, in accordance with article 3 of the General Regulations of the Law of Phytosanitary Police. (See Basic Law, P. 1, B. P. Q.-348.).

Article 2.—If on arrival in Chile a consignment of cottonseed is found to carry live insects, despite compliance with the requirements of the preceding article, it shall be fumigated, the operation to begin within 24 hours after unlading. If fumigation cannot be effected within the designated period, the Servicio de Sanidad Vegetal shall prevent the unlading of the shipment or proceed with its destruction after the lapse of 24 hours from unlading.

Article 3.—If the certificate referred to in article 1 cannot be obtained, the shipment shall be fumigated on board, before unlading is begun in the Chilean port, for a minimum period of 12 hours. If this treatment does not prove efficacious, a second fumigation shall be applied on board or on lighters or barges, and its landing shall not be permitted while live insects are found in the shipment.

Fumigation on board may be waived if the operation can be effected on lighters or barges on condition that both the unlading of such shipment and the fumigation

are carried out not less than 500 meters from shore. The shipment shall not be landed while specimens of live pink bollworms or other insects are found therein.

Article 4.—Shipments of cottonseed arriving by land, if not supported by the fumigation certificate referred to in article 1, shall be returned to the country of origin within a minimum period that will be determined by the Servicio de Sanidad Vegetal, or destroyed if the return is not effected within the stipulated period.

Article 5.—In all cases, this seed shall be ground immediately after it is received preference being given over any other, and not allowing the work to stop until the entire shipment has been manufactured.

Article 6.—The foregoing measures will not be required for seed proceeding from regions where pink bollworm does not exist, if such seed is subjected to the general provisions relating to the importation of seeds. In such case, the certificate shall explicitly declare that pink bollworm does not exist in the region where the seed was produced.

The cotton stainer, Dysdercus *sp.*

Article 7.—The phytosanitary certificate accompanying cottonseed intended for the production of oil proceeding from regions in which the cotton stainer, *Dysdercus* sp. exists shall clearly affirm that the shipment does not contain that insect. If the said insect does not occur in the region, that fact shall be stamped on the certificate.

Article 8.—The seed shall be inspected on board in the port of destination by the Servicio de Sanidad Vegetal.

Article 9.—If live cotton stainers are found, it will be treated in accordance with the provisions of the second article of this decree.

Article 10.—Unginned cotton or cottonseed imported from regions where the pink bollworm or the cotton stainer exist shall meet the requirements of articles 1, 2, 3, 4 and 5.

Article 11.—Importation of cotton will be permitted only in sacks ; these shall be so strong that they will not tear or burst during transportation or in lading or unlading. The unlading of torn sacks will not be permitted.

Cottonseed intended for sowing

Article 12.—The importation of seeds for sowing from regions in which pink bollworm occurs is prohibited, and all the other measures indicated in the present decree will be applied to the said seed.

Samples imported by mail

Article 13.—Samples without value arriving by mail will comply with the requirements of article 3 of the General Regulations of the Law of Phytosanitary Police only. (See p. 1, B. P. Q.-348).

Article 14.—Decree No. 1031 of September 30, 1935, is revoked.

(Sd.) Avery S. Hoyt,

Acting Chief, Bureau of Entomology and Plant Quarantine.

B. P. Q.-348, Supplement No. 5, dated September 10, 1936

Importation of beneficial insects

(Decree No. 458, April 27, 1935)

Article 1.—The importation of insects beneficial to agriculture, or of those which are natural enemies of others that constitute pests, may be effected only by the Phytosanitary Service of the Ministry of Agriculture of Chile.

Article 2.—The importation of other insects of direct economic value to private persons, such as bees, silkworms, etc., may be effected, provided that all the requirements established by the Law of Phytosanitary Police for the importation of plants, or parts thereof, are complied with.

Article 3.—Relates to the importation of birds, rodents, and other small animals, and article 4 deals with penalties for violations.

(Sd.) LEE A. STRONG,
Chief, Bureau of Entomology and Plant Quarantine.

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MEXICO

PLANT QUARANTINE IMPORT RESTRICTIONS OF THE REPUBLIC OF MEXICO BASIC LEGISLATION

The Constitution, Section I of article 69, and paragraph 111 of article 27. The Federal Pest Law of November 29, 1924 (Diario Official XXVIII, December 10, 1924)

SUMMARY

Importation prohibited

POTATOES (*Solanum tuberosum* L.): Importation prohibited from Maryland West Virginia, and Pennsylvania on account of the existence of potato wart [*Synchytrium endobioticum* (Schilb) Perc.] in those States. (Exterior Quarantine No. 4, Decree of June 26, 1927, see p. 15).

Fresh Fruits and Vegetables, except root crops such as onions, carrots, turnips, beets, etc., when free from soil: Importation prohibited from Africa (the entire continent and the islands thereof), Argentina, Australia, Azores, Bermuda, Brazil, Canary Islands, Cyprus, France, Greece, Hawaii, Hungary, Italy, Malta, New Zealand, Palestine, Portugal, Spain, Syria, and Tasmania, to prevent the introduction of the Mediterranean fruit fly (*Cetatitis capitata* Wied.) (Exterior Quarantine No. 5, Decree of July 17, 1927, as revised Jan. 27, 1936, effective Aug. 18, 1936).

Rice (*Oryza sativa* L.): Importation of seed or paddy rice prohibited from all countries except the United States to prevent the introduction of leaf smut (*Entyloma oryzae* Syd.), blight (*Oospora oryzetorum* Sacc.), take-all or foot-rot (*Ophiobolus cariceti* (B. & Br.) Sacc. (*O. graminis* Sacc.), glume blight (*Phoma glumarum* Ell. & Tr.), downy mildew (*Sclerospora macrocarpa* Sacc.) and flag smut of wheat (*Urocystis tritici* Koern.) (Exterior Quarantine No. 6, Decree of May 12, 1937, p. 16).

Sugarcane (*Saccharum officinalis* L.) : Importation prohibited from all sources to prevent the introduction of cane smut (*Ustilago saccari* Rabh.), downy mildew (*Sclerospora sacchari* Miy.), eye-spot disease (*Helminthosporium saccari* Butler), etc., except for scientific purposes and under special permit. (Exterior Quarantine No. 9, Decree of September 13, 1928, p. 18).

Alfalfa (*Medicago sativa* L.), plants and parts thereof (including seeds) in the fresh condition or as hay, proceeding from the States of Colorado, Idaho, Nevada, Oregon, Utah, and Wyoming, to prevent the introduction of the alfalfa weevil (*Phytonomus*) *Hypera postica* Gyll.). (Exterior Quarantine No. 12, Resolution of July 2, 1934, p. 20).

Exportation prohibited

Cactus plants, fruits, and seeds: Exportation from Mexico prohibited. (Regulations of June 28, 1930, and decision of December 20, 1933, p. 22).

Importation restricted

Seeds, plants, and parts thereof, for propagation : Each shipment must be accompanied by a phytosanitary certificate of competent authority of country of origin, affirming freedom from injurious pests and diseases, especially from virus diseases, and will be inspected on arrival in Mexico. Consular visa not necessary. (Resolution of October 17. 1934, p. 6). This does not apply to plants or plant products governed by special quarantines.

Citrus plants and parts thereof: Importation permitted under the provisions of regulation 47 of the Regulations of July 5, 1927 (p. 9) as a precaution against the introduction of citrus canker (*Racterium citri* Hasse), citrus root worms (*Tylenchus semipenetrans* Cobb.), the citrus black fly (*Aleurocanthus woglumi* Ashby), etc. (Exterior Quarantine No. 1 of Dec. 2, 1922, p. 12).

Coffee plants (*Coffea* spp.), and their various parts (roots, stems, flowers, fruits, and even the commercial coffee beans in the natural state) : Importation permitted only under the provisions of regulation 47 of the Regulations of July 5, 1927, as a precaution against the introduction of the coffee berry borer (*Stephanoderes coffeae* Hag.) (Exterior Quarantine No. 2, Decree of November 26, 1926, p. 13).

Cotton, seed cotton, cotton-seed, cotton-seed hulls: Importation subject to compliance with the provisions of regulation 47 of the Regulations of July 5, 1927, and to the special conditions set forth in Exterior Quarantine No. 3, Decree of February 4, 1926, as amended (see pp. 13 *et seq.*), to prevent the introduction of the pink bollworm (*Pectinophora gossypiella* Saund.) and other injurious pests.

Potatoes (*Solanum tuberosum* L.) : Importation subject to compliance with the provisions of regulation 47 of the Regulations of July 5, 1927. See also special provisions applying to the importation of potatoes grown in and exported from the United States (pp. 9 & 15). Precaution against the introduction of potato wart (*Synchytrium endobioticum* (Schilb.) Perc.), and the potato tuber

worm (*Gnorimoschema* operculella Zell.). (Exterior Quarantine No. 4, Decree of June 26, 1927).

Seed or paddy rice from the United States: Importation subject to compliance with the provisions of regulation 47 of the Regulations of July 5, 1927, to prevent the introduction of leaf smut (*Entyloma oryzae* Syd.), blight (*Oospora oryzetorum* Sacc.), take-all or foot-rot disease (*Ophiobolus cariceti* (B. & Br.) Sacc. (*O. graminis* Sacc.), glume blight (*Phoma glumarum* Ell. & Tr.), downy mildew (*Sclerospora macrocarpa* Sacc.), and flag smut of wheat (*Urocystis tritici* Koern.). (Exterior Quarantine No. 6, Decree of May 12, 1927, p. 16).

Wheat for seed purposes: Importation subject to an import permit and to a certificate issued by competent authority of the country of origin, visaed by the Mexican Consul, affirming that in the locality where grown the wheat was not infected by flag smut (*Urocystis tritici* Koern.), or take-all (*Ophiobolus cariceti* (B. & Br.) Sacc.). (Exterior Quarantine No. 8, Decree of July 23, 1931, and Resolution of July 30, 1931, pp. 17 and 18).

Peach, nectarine, almond and apricot plants and parts thereof, from the United States: Importation subject to the provisions of regulation 47 of the Regulations of July 5, 1927. A precaution against the introduction of so-called virus diseases: phoney peach, peach yellows, peach rosette, and little peach. (Exterior Quarantine No. 10, Decree effective August 14, 1929, p. 19).

Corn, broomcorn, sorghum, Sudan grass, straw, etc.: Application to be made in advance for an import permit, which, if issued, will indicate the conditions under which importation will be permitted. Precaution against the introduction of the European corn borer (*Pyrausta nubilalis* Hbn.). (Exterior Quarantine No. 11 as modified by Decree of June 27, 1931, p. 19).

Alfalfa (*Medicago satica* L.), plants and parts thereof (including seeds) in the fresh condition or as hay, proceeding from the State of California: Importer must obtain a special permit in advance and the shipment must be accompanied by a certificate affirming that the alfalfa weevil (*Phytonomus*) *Hypera postica* Gyll.) does not exist there. (Exterior Quarantine No. 12, Resolution of July 2, 1934, p. 20).

Seeds, plants, and parts of plants, including bulbs, rhizomes, stolons, layers, cuttings, etc., for propagation, not otherwise restricted or prohibited: Each shipment must be accompanied by a certificate issued by competent authority of the country of origin affirming freedom from injurious pests and diseases, and especially from virus diseases. (Resolution of October 17, 1934, pp. 6-8).

Importation unrestricted

Fresh fruits and vegetables from the United States of America: Except as restricted or prohibited by special quarantines, their importation into Mexico is unrestricted.

Dried or processed fruits and vegetables, cereals for food or manufacturing purposes, nuts: Importation unrestricted.

UNION OF SOUTH AFRICA

Union of South Africa Sugar Act, 1936: Department of Commerce and Industries Sugar Act, 1936 (Act No. 28 of 1936) together with Government Notice No. 1116 under Section *six* of the Act and Government Notice No. 1359 under Sub-section (1) of Section *one* of the Act including Sugar Industry Agreement, 1936

Act 28.]

ACT

TO PROVIDE FOR THE CONTROL OF THE SUGAR INDUSTRY BY AGREEMENTS ENTERED INTO BETWEEN GROWERS, MILLERS AND REFINERS OF SUGAR OR BY DETERMINATIONS MADE BY THE MINISTER OF COMMERCE AND INDUSTRIES, THE CONTROL OF THE PRICES AT WHICH CERTAIN SUGARS MAY BE SOLD OR DISPOSED OF, AND FOR MATTERS INCIDENTAL THERETO.

BE it enacted by the King's Most Excellent Majesty, the Senate and the House of Assembly of the union of South Africa, as follows :—

Publication of Agreements between Growers, Millers and Refiners.

1\. (I) If the Minister is satisfied :—

(*a*) that an agreement has been entered into, whether before or after the commencement of this Act, between representatives of growers, millers and refiners, in which provision is made—

(*i*) for a formula for determining a base price of sugar and for fixing, on the basis of such base price, the prices to be paid for sugarcane by millers to growers ;

(*ii*) for the regulation and restriction of the production of sugarcane and sugar, the regulation and control of the marketing and export of sugar, and the nature of the obligations of the various growers, millers and refiners in connection therewith ;

(*iii*) for the establishment of a board for the purpose of carrying out the agreement and for exercising such functions as may be assigned to such board thereunder ; and

(*iv*) for any other matter affecting the sugar industry, the inclusion of which in the agreement is approved or required by the Minister ;

(*b*) that such agreement has been approved—

(*i*) by not less than ninety per cent of growers who have together produced not less than ninety per cent of the total weight of sugarcane produced in the Union by growers during the twelve months ending upon the thirty-first day of December of the year preceding the year in which the agreement has been entered into ; and

(*ii*) by millers who have together manufactured not less than ninety per cent of the total weight of sugar manufactured in the Union by millers during the said twelve months; and

(*c*) that it would be in the public interest to publish the agreement under the provisions of this Act,

he may publish the agreement in the *Gazette*.

2. In calculating, for the purposes of sub-paragraph (*ii*) of paragraph (*b*) of sub-section (1), the total weight of sugar manufactured in the Union, the weight to be included in such total weight shall, in the case of raw sugar which has been refined, be the weight of the raw sugar.

3. If an agreement amending an agreement published under sub-section (1) is entered into between representatives of growers, millers and refiners, the Minister may, if he is satisfied that the amending agreement has been approved in the manner set forth in paragraph (*b*) of sub-section (1), and that it would be in the public interest to publish the amending agreement under the provisions of this Act, publish the amending agreement in the *Gazette*.

4. On the publication of the agreement or amending agreement in the *Gazette*, it shall become binding upon every grower who supplies sugarcane to any miller to whom a quota in respect of his manufacture of sugar has been assigned in terms of the agreement or amending agreement, upon every miller to whom such a quota has been so assigned, and upon every refiner, as if such grower, miller or refiner had signed the agreement or amending agreement.

Determination of terms of Agreement by Minister and Publication thereof.

2. (1) The Minister may—

(*a*) if at any time no agreement which has been published or which he is prepared to publish under section *one* is in existence, and if he is satisfied that it would be in the interest of the sugar industry to do so, determine the terms of an agreement between growers, millers and refiners in which provision is made for the matters referred to in paragraph (*a*) of sub-section (1) of section *one*;

(*b*) amend from time to time or revoke any determination so made; and

(*c*) publish such determination or amendment in the *Gazette*.

(2) On the publication of any such determination or amendment in the *Gazette*, it shall become binding upon every grower who supplies sugarcane to any miller to whom a quota in respect of his manufacture of sugar has been assigned in terms of the determination or amendment, upon every miller to whom such a quota has been so assigned, and upon every refiner, as if it had been an agreement or amending agreement, as the case may be, signed by such grower, miller or refiner.

Agreement or Determination may provide for different Rights and Obligations and for Levies upon Growers and Millers.

3. Any agreement, determination or amendment thereof published under section *one* or *two* may provide—

(*a*) that different growers, millers or refiners, or different classes of growers, millers or refiners, shall have different rights and obligations thereunder; and

(*b*) for levies upon growers or millers for the purpose of carrying out the terms of such agreement, determination or amendment.

Sugar of Prescribed Grade to be taken into account in determining Base Price of Sugar.

4. In determining the base price of sugar for the purpose of fixing the prices to be paid for sugarcane under any agreement or determination published under section *one* or *two*, the quantity of sugar of a grade prescribed under paragraph (*f*) of sub-section (1) of section *six*, which has been sold during the period with reference to which such base price is to be calculated, shall be included in the quantity of sugar upon which the calculation is to be based.

Grower or Miller to whom no Quota Assigned under Agreement or Determination.

5. (1) Notwithstanding anything contained in any agreement or determination or amendment thereof published under section *one* or *two*, any grower or miller upon whom, in terms of sub-section (4) of section *one* or of sub-section (2) of section *two* such agreement, determination or amendment is not binding, may sell, whether for manufacture or consumption, as the case may be, in the Union or elsewhere, any sugarcane or sugar produced or manufactured by him.

(2) During the currency of any such agreement or determination every such miller shall, in respect of each year and not later than six months after the expiry thereof:—

(*a*) export a quantity of sugar which bears, in relation to the total quantity of sugar manufactured by him during that year, the same proportion as the total quantity of sugar exported in terms of such agreement, determination or amendment during that year by millers to whom quotas in respect of the production of sugar have been assigned under such agreement, determination or amendment, bears to the total quantity of sugar manufactured by such millers during that year; and

(*b*) sell or place at the disposal of the board for sale on his behalf to manufacturers who are entitled to a rebate in price in respect of sugar purchased by them from the millers referred to in paragraph (*a*) or from refiners, at the same rebate in price as is allowed to such manufacturers by such millers or refiners, a quantity of sugar of a grade required by such manufacturers which bears the same proportion in relation to the total quantity of sugar manufactured by him during that year as the total quantity of sugar sold to such manufacturers as a rebate during that year by such millers and refiners, bears to the total quantity of sugar manufactured by such millers during that year,

(3) Whenever the board receives or makes in respect of any year any estimate in connection with the quantity of sugar which :—

(*a*) will be exported in terms of any such agreement, determination or amendment ; or

(*b*) will be sold at a rebate to manufacturers referred to in paragraph (*b*) of sub-section (2) ; or,

(*c*) will be manufactured,

by millers to whom quotas have been assigned as described in that sub-section, or by refiners, as the case may be, it shall inform every miller referred to in sub-section (1) of the particulars of such estimate.

(4) For the purposes of sub-section (2), the total quantities of sugar which, according to the final estimate made by the board in respect of any year, have during that year been exported, sold or manufactured as described in sub-section (3), shall be deemed to be the total quantities of sugar so exported, sold or manufactured, as the case may be.

(5) No miller shall be relieved of his obligations under sub-section (2) in respect of any sugar by reason of the fact that he is unable to acquire such sugar by purchase.

Power of Minister to Prescribe Sugar Prices, Maximum Output of White Sugar and Grade of Sugar to be Sold at Fixed Price.

6. (1) The Minister may by notice in the *Gazette*—

(*a*) prescribe that the maximum price at which refined sugars may be sold or disposed of by retail by any person in Durban, East London, Port Elizabeth, Mossel Bay and Cape Town, for consumption in the Union shall not exceed three and one half pence per pound and that the maximum price at which all or any grades of mill white sugars may be so sold or disposed of in the said places, shall not exceed three pence farthing per pound ;

(*b*) prescribe that the maximum price at which any particular grade of sugar, other than a refined sugar or a mill white sugar for which a maximum price has been prescribed under paragraph (*a*), may be sold or disposed of by retail by any person in any of the places referred to in paragraph (*a*) and in all places situated within a radius of five miles from any railway station siding or halt, for consumption in the Union, shall not exceed two pence half penny per pound ;

(*c*) after enquiry by the Board of Trade and Industries, prescribe the prices at which sugars may be sold or disposed of by retail in the Union or in any portion thereof, for consumption therein : Provided that in the case of any grade of sugar for which a maximum price has been prescribed under paragraph (*a*) or (*b*), the price prescribed under this paragraph shall not, at the places referred to in paragraph (*a*) or (*b*), as the case may be, exceed such maximum price.

(*d*) if upon investigation he is satisfied that the base price of sugar as determined for any year for the purpose of fixing the prices to be paid for

sugarcane under any agreement or determination published under section *one* or *two* and in force during that year has exceeded twelve pounds per ton, prescribe a reduced price at which all or any grades of sugar shall be sold or disposed of by manufacturers for consumption in the Union and the mandated territory ;

(*e*) determine the maximum quantity of white sugar which may be sold or disposed of by millers and refiners for consumption in the Union and the mandated territory in any one year during the period during which any agreement or determination under section *one* or *two* is in force ;

(*f*) prescribe a grade of sugar which shall, during any year in respect of which a maximum price for a particular grade of sugar has been prescribed under paragraph (*b*), be sold by millers for consumption in the Union and the mandated territory at a maximum price of fourteen pounds ten shillings per ton, free on rail at Durban.

(2) If the Minister has prescribed a grade of sugar under paragraph (*f*) of sub-section (1) in respect of any year, every miller shall during that year manufacture and sell for consumption in the Union or the mandated territory and at a price not exceeding the price referred to in the said paragraph, such quantities of sugar of the grade prescribed under the said paragraph and at such times as the board may from time to time require of such miller : Provided that the board shall not during any year require any miller so to manufacture and sell a greater quantity of sugar of the said grade than a quantity which bears the same proportion, according to the estimate of the board, to the total quantity of such sugar which will be so manufactured and sold by millers during that year, as the total quantity of sugar which such miller will manufacture for such consumption during that year bears to the total quantity of sugar which will be manufactured by all millers for such consumption during that year.

(3) The Minister may amend from time to time or revoke any notice issued under this section.

Miller may arrange with other Miller to carry out his Obligations.

7. Any miller upon whom under the provisions of sub-section (2) of section *five* or under any similar provisions relating to the export of sugar or the sale of sugar to manufacturers by millers, contained in an agreement, determination or amendment thereof published under section *one* or *two* or under the provisions of sub-section (2) of section *six*, and obligation is imposed, may relieve himself of that obligation by entering into an agreement with a refiner or another miller whereby that refiner or miller undertakes to fulfil that obligation, and thereupon such refiner or other miller shall be subject to that obligation and liable to any penalty provided for the failure to fulfil the same.

Evidence.

8. Proof of publication in the *Gazette* of any agreement or amending agreement under section *one* shall, in the absence of proof of fraud, be conclusive evidence that all the provisions of that section, and of any regulations made under this Act, in respect of matters precedent and incidental to the publication of such agreement or amending agreement, have been complied with.

Penalties.

9. (1) Any person who—

(*a*) sells or disposes of any sugar under the representation that it is refined sugar whereas in fact it is not such ; or

(*b*) contravenes or fails to comply with the provisions of paragraph (*a*) or (*b*) of sub-section (2) of section *five* or any similar provisions relating to the export of sugar or the sale of sugar to manufacturers by millers, contained in an agreement, determination or amendment thereof published under section *one* or *two*, or the provisions of sub-section (2) of section *six*, or of a notice issued under paragraph (*a*), (*b*), (*c*) or (*d*) of sub-section (1) of section *six*.

shall be guilty of an offence and liable on conviction to a fine not exceeding one hundred pounds or to imprisonment for a period not exceeding six months, or to both such fine and imprisonment.

(2) If any person is convicted of an offence referred to in paragraph (*b*) of sub-section (1), other than a contravention or failure to comply with the provisions of a notice issued under paragraph (*a*), (*b*) or (*c*) of sub-section (1) of section *six*, the court convicting him shall enquire into and estimate the amount of the profit made by him in consequence of his having committed such offence, and shall, in addition to any sentence which it may impose under sub-section (1), impose on the person so convicted a fine equal to the amount of the profit which the court so estimates he made in consequence of his having committed such offence.

(3) Notwithstanding anything contained in any other law magistrates' courts shall have jurisdiction to impose any penalty prescribed by this Act.

Application of Act.

10. The provisions of paragraphs (*a*), (*b*) and (*c*) of sub-section (1) of section *six*, and of paragraph (*a*) of sub-section (1) of section *nine*, shall not apply to candy, loaf, castor, icing or cube sugar.

Regulations.

11. (1) The Governor-General may make regulations for the better carrying out of the objects and provisions of this Act and of any agreement or determination or amendment thereof which has been published under section *one* or *two*.

(2) Any regulations made under this section may prescribe penalties for any contravention thereof or failure to comply therewith not exceeding imprisonment for a period of six months together with a fine of fifty pounds.

Repeal of Act No. 47 of 1926, and section eleven of Act No. 25 of 1932.

12. The Sugar Prices Act, 1926, and section *eleven* of the Financial Adjustments Act, 1932, are hereby repealed.

Interpretation of Terms.

13. In this Act, unless inconsistent with the context—

"the board" means the board established under any agreement or determination published under section *one* or *two* ;

"grower" means a person who produces sugarcane for the purpose of the manufacture of sugar: Provided that for the purposes of paragraph (*b*) of sub-section (1) of section *one*, "grower" shall not include—

(*i*) a person of non-European descent; or

(*ii*) a person who manufactures sugar; or

(*iii*) a person who is a director of a company which manufactures sugar; or

(*iv*) a partnership, syndicate or company in which a person who manufactures sugar or who is a director of a company which manufactures sugar holds an interest of more than one-third;

"mandated territory" means the mandated territory of South-West Africa;

"miller" means a person who manufactures sugar from sugarcane;

"Minister" means the Minister of Commerce and Industries;

"refiner" means a person who converts raw sugar into refined sugar at a refinery;

"refined sugar" means all such sugars of refined quality as have been refined by the bone-char-filter, the vegetable-carbon or the carbonatation process;

"year" means a period of twelve months ending upon the thirtieth day of April.

Short Title.

14. This Act shall be called the Sugar Act, 1936.

GOVERNMENT NOTICE.

DEPARTMENT OF COMMERCE AND INDUSTRIES.

The following Government Notice is published for general information:—

No. 1116.] [31st July 1936.

NOTICE UNDER SECTION *SIX* OF THE SUGAR ACT, 1936.

Under and by virtue of the powers vested in me by sub-section (1) of section *six* of the Sugar Act, 1936 (Act No. 28 of 1936), I, ADRIAN PAULUS JOHANNES FOURIE, Minister of Commerce and Industries, do hereby prescribe—

(*a*) that the maximum price at which refined sugars may be sold or disposed of by retail by any person in Durban, East London, Port Elizabeth, Mossel Bay and Capetown, for consumption in the Union, shall not exceed three and one-half pence per pound and that the maximum price at which mill white sugars may be sold or disposed of in the said places shall not exceed threepence farthing per pound;

(*b*) that the maximum price at which the grade of sugar referred to in paragraph (*c*) of this notice may be sold or disposed of by retail by any person in any of the places referred to in paragraph (*a*) and in all places situated within a radius of five miles from any railway station, siding or halt,

for consumption in the Union, shall, during the period ending upon the thirtieth day of April, 1937, and during any subsequent period of twelve months ending upon the thirtieth day of April, not exceed twopence half-penny per pound ;

(c) that the sugar of not less than 98° polarisation, which is described by millers as the South African Sugar Industry's Standard 2 grade sugar, shall, during the period ending upon the thirtieth day of April, 1937, and during any subsequent period of twelve months ending upon the thirtieth day of April, be the grade of sugar to be sold by millers for consumption in the Union and the Mandated Territory at a maximum price of fourteen pounds ten shillings per ton (2,000 lb.) free on rail at Durban.

A. P. J. FOURIE,
Minister of Commerce and Industries.

C. I. 135/1/18.

GOVERNMENT NOTICE.

DEPARTMENT OF COMMERCE AND INDUSTRIES.

The following Government Notice is published for general information :—

No. 1359.] [11th September 1936.

NOTICE UNDER SECTION ONE OF THE SUGAR ACT, 1936.

I, Nicolaas Christiaan Havenga, Acting Minister of Commerce and Industries, being satisfied :—

(a) that the Agreement between growers, millers and refiners appearing as a Schedule hereto, complies with the terms of sub-section (1) (a) of section *one* of the Sugar Act, 1936 ;

(b) that the said Agreement has been approved by growers and millers in the manner provided in sub-section (1) (b) of section *one* of the said Act ; and

(c) that it would be in the public interest to publish the said Agreement under the provisions of the said Act ;

do hereby publish the said Agreement in terms of sub-section (1) of section *one* of the Sugar Act, 1936.

N. C. HAVENGA,
Acting Minister of Commerce and Industries.

SCHEDULE.

SUGAR INDUSTRY AGREEMENT.

This Memorandum of Agreement made between the Natal Sugar Millers Association, on behalf of millers (and of such refiners of sugar as are members of such Association), and the South African Cane Growers' Association, on behalf of growers, which

Associations warrant by their signatures hereto that this agreement has been approved of or concurred in by or on behalf of (*a*) *growers* within the meaning of section *one* (1) (*b*) of the Sugar Act, 1936, who produced not less than 90 per cent in weight of the total amount of sugarcane produced by such growers in the Union during the twelve months ending on the 31st December, 1935, and who were not less than 90 per cent in number of such growers, and (*b*) *millers* who produced not less than 90 per cent in weight of the total output of sugar manufactured in the Union during the said twelve months, which Agreement is concurred in, as parties also thereto, by—

(1) Umfolozi Co-operative Sugar Planters, Ltd.,

(2) Doornkop Sugar Estates, Ltd.,

(3) J. H. Shire,

(4) Entumeni Sugar Milling Co. (Pty.), Ltd., and

(5) Glendale Sugar Estates,

being the only millers in the Union who are not members of the said Millers' Association and who produced the balance in weight of the total output of sugar aforesaid, and also by Hulett's South African Refineries, Limited, being the only refiners of sugar in the Union who are not members of the said Millers' Association.

witnesseth:

Whereas during the month of March, 1936, a Plenary Conference of representatives of the growers of sugarcane and millers and refiners of sugar within the Union was held at Durban by direction of the Minister of Commerce and Industries, and under the supervision of a chairman by him appointed;

And whereas on the 23rd day of March, 1936, the representatives aforesaid agreed upon and subscribed to the essential terms of an Agreement for the future regulation and control of the Sugar Industry, one of which was that the Agreement should come into force and be binding as from the first day of May, 1936;

And whereas such Agreement was entered into with a view to legislation being enacted by Parliament, providing in general for such regulation and control and in particular for the said Agreement being made binding upon all growers, millers and refiners within the Union;

And whereas such legislation has been passed by the Senate and House of Assembly and has received the Royal Assent, and has been promulgated as the Sugar Act, 1936;

And whereas these presents have been drawn up in due form, containing the essential terms aforesaid together with such amplification of detail as is required by the provisions of the legislation aforesaid, by a Drafting Committee appointed in that behalf by the Plenary Conference aforesaid, and acting pursuant to the authority conferred upon it by such Conference;

And whereas the said Plenary Conference was substantially representative of the whole of the Sugar Industry of the Union.

And whereas these presents have been approved of or concurred in by growers and millers as provided in the said Sugar Act, 1936;

Now therefore :

Interpretation Clause.

In this Agreement, unless inconsistent with the context—

"Millers' Association" means The Natal Sugar Millers' Association ;

"Growers' Association" means The South African Cane Growers' Association ;

"Sugar Association" means The South African Sugar Association ;

"Hulsar" means Hulett's South African Refineries, Limited ;

"Central Board" means the Sugar Industry Central Board ;

"Umfolozi" means the Umfolozi Co-operative Sugar Planters, Limited ;

"Doornkop" means the Doornkop Sugar Estates, Limited ;

"Shire" means J. H. Shire ;

"Entumeni" means The Entumeni Sugar Milling Co. (Proprietary), Limited ;

"Glendale" means Glendale Sugar Estates ;

"Huletts" means Sir J. L. Hullett & Sons, Limited ;

"Zululand S. M. & P." means Zululand Sugar Millers and Planters, Limited ;

"Natal Estates" means The Natal Estates, Limited ;

"Tongaat" means The Tongaat Sugar Company, Limited ;

"Central Factory" means Central Factory (Proprietary), Limited ;

"Melville" means Melville Sugar Company, Limited ;

"New Guelderland" means New Guelderland Sugar Factory ;

"Prospecton" means Prospecton Sugar Estates, Limited ;

"Gledhow" means The Gledhow-Chakas Kraal Sugar Company, Limited ;

"Illovo" means Illovo Sugar Estates, Limited ;

"Crookes" means Crookes Bros., Limited ;

"Reynolds" means Reynolds Bros., Limited ;

"Umzimkulu" means The Umzimkulu Sugar Company, Limited ;

"Smith Group" means the Group of Sugar Milling Companies for whom C. G. Smith & Co., Ltd., act as distributors of sugars manufactured ;

"Delville Estates" means Delville Estates, Limited ;

"Nkwaleni Planters" means planters who at 23rd March, 1936, were growing cane in the area known as the Nkwaleni Lots as shown on Cadastral Sheets Nos. 42 and 43, Series 1 : 63,360, prepared in the Surveyor-General's Office, Pietermaritzburg, and issued by the Government Printer, Pretoria, in 1934 ;

"Mill" includes owner of a mill ;

"Grower", "miller", "Minister" and "refiner" shall have the meanings assigned to them by the Sugar Act, 1936.

Introduction.

1. This Agreement shall upon publication thereof by the Minister in the *Union Government Gazette* in pursuance of the Sugar Act, 1936, be and become binding upon all growers, millers and refiners, as therein provided.

2. This Agreement shall be operative from the 1st day of May, 1936, and shall subsist for a period of five years, but it shall be subject to amendment, save as to such period, in the manner provided by the said Act.

CHAPTER I.—CENTRAL BOARD.

3. As from the date of commencement of this Agreement there shall be established a Board to be known as the Sugar Industry Central Board, hereinafter referred to as the Central Board.

4. The Central Board shall consist of three members namely :—

(1) a chairman appointed by the Sugar Association ;

(2) a growers' representative, appointed by the Growers' Association ;

(3) a millers' representative, appointed by the Millers' Association.

5. The first members of the Central Board shall be appointed upon this Agreement becoming operative as provided in clause I hereof. In the event of the chairman not being appointed within one month thereafter the Minister shall be requested to nominate a chairman, and his nominee shall forthwith be appointed by the Sugar Association.

6. The chairman shall hold office until removed by the Sugar Association, and the remaining first members shall hold office until the 30th of June, 1937. Such remaining members shall then and thereafter be appointed annually in the month of June in each year.

7. The chairman shall have no financial interest in the Sugar Industry and shall receive a salary to be fixed by the Sugar Association. The remaining members may receive such remuneration as may be determined by the said Association.

8. In the event of any vacancy arising from death, resignation, or other cause, in the office of a member of the Central Board (including in the case of the chairman, his removal), such vacancy shall be filled within one month in the case of the chairman by the Sugar Association, and in the case of a growers' or millers' representative by appointment as hereinbefore set out. Any member so appointed or elected to fill a vacancy shall hold office on the same terms as to period as his predecessor. In the event of any vacancy in the office of chairman not being filled within one month the Minister shall be requested to nominate a chairman, and his nominee shall forthwith be appointed by the Sugar Association.

9. If at any time the chairman of the Central Board is from any cause prevented from attending any meeting of the Board, the Council of the Sugar Association shall appoint some person to act temporarily as chairman in his place, and if at any time the growers' representative or the millers' representative is so prevented, the Growers' Association or the Millers' Association, as the case may be, shall appoint some person to act temporarily as an alternate member in his place. Whilst so acting any such person shall have all the powers of and be deemed to be the chairman or a member of the Central Board as the case may be. Alternate members representing the growers and millers may be appointed by their respective Associations in advance to act from time to time as occasion may require.

10. At any meeting of the Central Board three members shall form a quorum and all questions shall be decided by a majority save as may be otherwise specially provided herein.

11. The Central Board may make such rules and regulations as it deems necessary or expedient and are not in conflict with the provisions hereof :—

(a) prescribing the meetings to be held by the Central Board, the proceedings thereat, the conduct of the business of the Central Board, and the records to be kept by the Central Board of its proceedings ;

(b) prescribing the methods by and the form in which the Central Board shall keep its accounts, and the manner in which they shall be audited ;

(c) generally for the better carrying out of the provisions of this agreement in so far as they relate to the functions of the Central Board ;

12. The Central Board shall have power :—

(a) to undertake and carry out all such duties or activities and to exercise all such powers as are assigned to or conferred upon it by this Agreement ;

(b) to undertake and carry out all such duties or activities and to exercise all such powers as may from time to time be assigned to it by or in pursuance of the Sugar Act, 1936 ;

(c) to undertake and carry out all such duties or activities and to exercise all such powers as may from time to time be lawfully assigned to it by the Council of the Sugar Association ;

(d) to conduct any such investigations or inquiries as it may deem necessary or desirable in the interests of the Sugar Industry for the better carrying out of the purposes of this Agreement ;

(e) to come to such decisions and to give all such notifications or directions, with respect to matters within its jurisdiction, as it may deem necessary or expedient to give due effect thereto or for the carrying out of the objects and purposes of this Agreement ;

(f) to call in to assist it in its deliberations and for other advisory purposes, technical or otherwise, such persons as it may consider fit ;

(g) to appoint such persons as it considers necessary to enable it to exercise its functions, at such remuneration and on such conditions as it may determine ;

(h) to acquire or hire any property which it considers necessary for the purpose of exercising its functions, and to dispose of or let any property which it has acquired ;

(i) to receive, control and administer the Central Fund and to open banking accounts, to sign by itself or any person duly appointed by it in that behalf cheques, bills of exchange, and other documents for the purpose of collecting, investing and disbursing moneys, and to make all payments which may be necessary in the exercise of its functions hereunder ;

(j) generally to do all such other acts, matters and things as shall be incidental to the proper carrying out of the powers conferred upon it hereunder.

13. In the event of any question or dispute arising out of or in connection with the interpretation or operation of this Agreement between any persons upon whom

this Agreement shall become binding, the determination of which is not herein specifically provided for, such question or dispute shall be submitted to the members of the Central Board sitting as three individual arbitrators, and not as the Board, for determination and award in accordance with the provisions of the Arbitration Acts from time to time in force in the Province of Natal. provided that :—

(a) for the determination of any such question or dispute and in any award the decision of the said members must be unanimous ;

(b) in the event of the said members being unable to arrive at a unanimous decision, they shall appoint (by a majority if need be) an umpire who shall be an advocate of the Supreme Court of South Africa of at least seven years standing and shall submit the question or dispute to him for determination. The umpire's award shall be final.

14. There shall be established under the administration of the Central Board, a fund to be called "the Central Fund" which shall be charged with the payment of all costs and expenses incurred by the Central Board in pursuance of the provisions of this agreement and of the regulations as herein prescribed.

15. The amount required for the Central Fund shall be an Industry obligation as hereinafter defined and shall be met by a levy imposed as hereinafter provided for in this Agreement and in the Constitution of the said Sugar Association which is set out in Schedule "E" hereto annexed. All amounts levied and collected hereunder shall be paid forthwith into the Central Fund.

CHAPTER II.—CONTROL OF PRODUCTION.

16. There are hereby allocated to mills, mill sugar quotas as set out in Schedule "A" hereto annexed. Each quota represents the maximum output permitted in any one season from the mill concerned, and no mill shall exceed its quota save in accordance with the next succeeding clause hereof, provided that during the 1936-37 season Prospection may produce 5,000 tons.

17. When the Central Board is satisfied that additional cane is available to fill the undermentioned sugar quotas in whole or in part it shall, on application by the growers or millers concerned, allocate the following sugar quotas or portions thereof, as the case may be, additional to those set out in Schedule "A" aforesaid, *viz.* :—

Nkwaleni Planters	5,000 tons.
Umfolozi	5,000 tons.
Shire	250 tons.
Glendale	650 tons.
For contingencies (for allocation to any mill or mills in the discretion of the Central Board)	1,412 tons.
	12,312 tons.

In the event of the whole or any portion of the above tonnage being allocated by the Central Board, the tonnage so allocated shall be deducted proportionately from the original quotas as set out in Schedule "A" annexed hereto of all mills and such quotas shall be reduced accordingly.

18. The quota allocated in Schedule " A " aforesaid, and that available for allocation in terms of the preceding section hereof, to Nkwaleni Planters, shall be and become a part of the quota of the mill or mills, as the case may be, to which the cane produced by such planters shall be delivered, *pro rata* to such deliveries.

19. (*a*) If at any time in the opinion of the Central Board the output of sugar in any season will exceed the total quantity of sugar to be sold locally and exported in that season it may, without prejudice to the provisions of clause 17, reduce mill sugar quotas in the ratio that such total quantity as estimated by it bears to 476,488.

(*b*) In such event the Central Board shall ascertain the estimates of production of individual mills and shall allocate the total of any amounts by which such individual estimates fall short of the reduced quotas of the mills concerned, to the remaining mills in the ratio of the individual reductions suffered by such remaining mills—the reductions being the amounts by which their estimates of production for the season in question exceed their reduced quotas for that season.

(*c*) Any mill which is unable to fill its reduced quota for any season shall not later than the 31st day of October notify the Central Board which shall allocate the amount of such shortfall to mills with surpluses *pro rata* to the amounts of such surpluses, provided, however, that no mill shall thereby receive a total quota in excess of its quota as set out in Schedule " A ".

20. If any mill is unable to fill its quota owing to lack of cane supplies and there is surplus cane available which was grown for delivery to another mill, but cannot be allocated by the Mill Group Board of such latter mill because it would be in excess of its mill cane quota and result in an excess over the mill's sugar quota, the Central Board, if satisfied that such surplus has not occurred as a result of any deliberate breach of the quota provisions of this Agreement, may allocate such surplus to the mill with the shortfall up to but not exceeding the amount required to meet the shortfall in question.

21. The Central Board shall have jurisdiction to determine any question relating to mill sugar quotas not specifically provided for in this Agreement.

22. As soon as possible after this Agreement shall come into operation there shall be established for each mill a Mill Group Board. Each Mill Group Board shall consist of not more than five members appointed by the growers supplying such mill and the miller owning such mill. Members shall be appointed annually and casual vacancies shall be filled by the growers or the miller as the case may be. In the event of a dispute, the Central Board shall fix the respective representations. All questions for decision shall be decided by a majority and each Mill Group Board may formulate its own rules of procedure.

23. Not later than the 30th day of April in each year each mill shall notify its Mill Group Board of the amount of its sugar quota for the forthcoming season and of the quantity of cane it requires to enable such quota to be filled. Failing such notification, the Mill Group Board shall estimate the quantity of cane so required. Such quantity of cane is hereafter referred to as the Mill's cane quota.

24. (*a*) Thereafter not later than the 31st day of May in each year the Mill Group Board shall allocate to the non-European section of the mill's suppliers a portion of the mill's cane quota based on the ratio of non-European sectional peak supplied to the mill between the years 1931-32 to 1935-36, to total peak supply for the same period.

(b) Each miller may, if he deems it advisable, forthwith establish a Non-European Board representative of the miller and the Non-European suppliers of such mill to deal with such portion for and on behalf of the Mill Group Board, and subject to its approval.

(c) The Non-European Board or the Mill Group Board, as the case may be, shall deduct from such portion so allocated a quantity sufficient to make provision for increased output for small non-European growers, and for preferential assignments to such growers where it can be shown that the financial commitments of such individual growers as at 23rd March, 1936, were such that special consideration is justified. This quantity shall be at the disposal of such Board for the purposes stated, and may be allocated by it in the form of quotas additional to the standard cane quotas provided for in the next succeeding sub-paragraph hereof.

(d) The Non-European Board or the Mill Group Board, as the case may be, shall allocate to individual non-European suppliers standard cane quotas for the ensuing season to absorb the balance of such portion so allocated, such standard cane quotas being proportionate to the highest average of individual supplies to any mill of two consecutive years between the years 1931-32 and 1935-36. In the case of Glendale, the mill shall take from its growers cane sufficient to manufacture not less than 50 per cent of the mill's allocation of sugar in any season when such cane is available. If sufficient cane is not available from its growers as aforesaid, the Glendale Sugar Estates shall be entitled to supply its own cane to make up the deficiency between the growers' cane and the mill's cane quota.

(e) Not later than the 15th October in each year, the Non-European Board or the Mill Group Board, as the case may be, shall ascertain the quantity of cane still to be cut by each non-European supplier, and in the event of any such supplier being found to be unable to fulfil his allocated quota of cane (whether standard or additional) in any season, the said Board shall allocate such shortfall to non-European suppliers with surpluses *pro rata* to such surpluses. In the event of non-European suppliers being unable to make up any such shortfall in whole or in part, it shall become available *pro tanto* for allocation to European suppliers with surpluses *pro rata* to such surpluses.

25. Not later than the said 31st day of May in each year the Mill Group Board shall further —

(a) deduct from the mill's cane quota a quantity sufficient to make provision for increased output for small European growers and for preferential assignments where it can be shown that the financial commitments of individual European growers as at 23rd March, 1936, were such that special consideration is justified. This quantity shall be at the disposal of the Mill Group Board for the said purposes and may be allocated by it in the form of quotas additional to standard cane quotas as provided for in the next succeeding sub-paragraph hereof. Applications for such additional quotas may be made by European growers qualified therefor at any time prior to the said 30th day of April. A small European grower shall be entitled to an additional quota so as to bring his individual quota up to a maximum of 3,500 tons, provided that the Mill Group Board is satisfied that such small grower has a reasonable prospect of

producing during the season in question the additional quota applied for by him ;

(*b*) allocate to individual European suppliers including the miller himself where he crushes cane grown by him, standard cane quotas for the ensuing season to absorb the balance of the mill's cane quota, to the extent that it represents the peak production of the mill as shown in Schedule " A " aforesaid, such standard cane quotas being proportionate to the highest average of individual supplies to any mill of two consecutive years between the years 1931-32 and 1935-36 ;

(*c*) allocate to individual European suppliers excluding any miller-*cum*-planter, supplementary cane quotas to absorb the balance of the mill's cane quota to the extent that it represents the excess, if any, of the mill's sugar quota over its peak production as shown in Schedule " A " aforesaid, in similar proportions to those specified in (*b*) hereof. In this sub-section miller-*cum*-planter shall mean any miller or any subsidiary company in which millers owned more than 52½ per cent of the capital on the 23rd March, 1936 ;

(*d*) Not later than the 15th October in each year each Mill Group Board shall ascertain the quantity of cane still to be cut by each European supplier, and in the event of any European supplier being found to be unable to fulfil his allocated quota of cane (whether standard, supplementary or additional) in any season, the Mill Group Board shall allocate such shortfall to European suppliers with surpluses *pro rata* to such surpluses. In the event of European suppliers and the miller being unable to make up any such shortfall in whole or in part it shall become available *pro tanto* for allocation to non-European suppliers with surpluses *pro rata* to such surpluses.

26. In the event of the mill sugar quota of any mill being adjusted by the Central Board in respect of any season, such adjustment shall be notified by the mill to the Mill Group Board and the Non-European Board, if any, which shall forthwith make and notify the suppliers, whether European or non-European, and to the mill the necessary proportionate adjustments, in the supplementary cane quotas and, if they are not sufficient, in the standard cane quotas of European and non-European supplies and the miller so as to reduce the total of cane quotas to the amount of cane required to fulfil the adjusted mill sugar quota.

27. Millers and growers undertake to afford Mill Group Boards all information reasonably necessary to enable cane quotas to be allocated as aforesaid.

28. (*a*) The allocation of a cane quota shall be regarded as attaching to the allottee in respect only of the farm or lands from which he delivered cane during the 1935-36 season, or had planted with cane for delivery, prior to the 1st May, 1936, and in respect only of the miller to whom he so delivered or is under contract to deliver.

(*b*) No alteration in the terms of such allocation either as regards the allottee, the farm or lands, or the miller, shall be made without the prior consent of the Central Board, who shall have jurisdiction to decide all questions of change of allottee, transfer to another farm or other lands, and change of the miller concerned, and all other cognate

questions such as sub-division of the farm or lands, allocation upon the termination of leasehold titles or the like.

(c) The Central Board shall not be entitled to give any decision under the provisions of this clause the result of which will cause a breach of an existing contract between interested parties, nor by such decision to confer upon any person greater rights in respect of a quota than the original or prior holder thereof.

(*d*) If by reason of the circumstances of the case any quota shall lapse the Central Board may authorise the Mill Group Board to allocate it upon such terms and conditions as shall be approved by such Central Board.

(*e*) In exercising the jurisdiction by this clause conferred the Central Board shall before coming to any decision give all interested parties the opportunity of being heard before it. It shall in such exercise act reasonably and equitably according to the circumstances of the case, and its decisions shall at the instance of any person thereby aggrieved be subject to the common law jurisdiction by way of review which is vested in the courts of law.

(*f*) Notwithstanding all the foregoing where—

(*i*) the only alteration of any allocation sought is a *bona fide* change from the farm or lands to which it applies (either in whole or in part) to another farm or lands owned or held by the same person ;

(*ii*) the allocation to such person and the incidence thereof remain otherwise entirely unaffected in every respect ;

(*iii*) the allocation of any other person is entirely unaffected in every respect and no new allocation is sought ; and

(*iv*) the alteration in question does not involve any breach of any contract ;

then such alteration may be effected without the consent of the Central Board, provided that such person shall give notice in writing to it before he supplies any cane from such substituted farm or lands.

29. Any decision of or allocation by a Mill Group Board shall be subject to appeal by any interested party to the Central Board, whose decision thereon shall be final.

30. Mill Group Boards shall be subsidiaries of and responsible to the Central Board and shall carry out any and all the directions and instructions of the Central Board respecting the discharge of their duties hereunder.

31. The Mill Group Board shall, subject to the appeal to the Central Board hereinbefore set out, have jurisdiction to determine any question relating to mill cane quotas not specifically provided for in this Agreement.

CHAPTER III.—SUPPLY OF CANE AND CANE PRICE.

32. Millers undertake to accept supplies of cane delivered or tendered for delivery by growers to the extent of growers' individual cane quotas, and undertake not to accept supplies in excess thereof nor to crush cane grown by themselves in excess of their own individual cane quotas.

33. Cane delivered or tendered for delivery as aforesaid shall (subject to the provisions of clause 52 hereof) be deemed to be so delivered or tendered in pursuance of a contract for the sale and purchase of such cane on the terms and conditions herein set out.

34. All cane shall be deliverable by the grower at his own expense at the mill or site to which he is obliged under any existing contract to deliver or, in the absence of any existing contract, to the mill to which he delivered his cane during the 1935-36 season, but where under an existing contract railage on cane is paid either in whole or in part by the miller, the grower shall not be required to pay more than he was obliged to pay in the past under such contract.

35. Notwithstanding the provisions of clause 34 hereof, millers may, subject to the quota provisions of this Agreement, divert supplies of cane to any mill, provided that the grower whose cane is diverted shall receive no more nor less than the price payable to him in terms of clause 40 hereof.

36. Any savings on railage effected by diversion adjustments between Huletts and any other mills shall be credited to Huletts.

37. Cane may be hand thrashed or burnt at the grower's option.

38. Deliveries to the mill shall be made by the grower rateably over the crushing season in accordance with existing agreements unless otherwise agreed.

39. Tram-line agreements and charges are a matter of arrangement between miller and grower, but as "tramline losses" have been included in milling costs for the purposes of the cane price scale the miller undertakes not to raise existing charges during the term of this Agreement. Tongaat may undertake capital expenditure up to £10,000 for the construction of a tram line to De Jager's and the supply of rolling stock thereto.

40. All cane delivered by a grower to a miller during a milling season shall be paid for, and the price shall be determined—

(a) upon the basis of his season's average sucrose in accordance with the marginal formula contained in Schedule "B" annexed hereto and the chemists' scale contained in Schedule "C" annexed hereto, and,

(b) in the case of European growers in accordance with the provisions of Schedule "D" annexed hereto providing for the establishment, administration and distribution of the Equalisation Fund, and in the case of non-European growers in accordance with the provisions of the supplement to such schedule.

41. In the event of the railage rates on sugar from any mill to the point of delivery by such mill being reduced subsequent to 23rd March, 1936, the benefit of such reduction shall be shared equally between the miller on the one hand and all the suppliers of cane to such mill, including the miller, on the other, and shall be spread over the total cane supplies for any season. Millers undertake to pay growers' proportion of such benefit to them *pro rata* to sucrose contained in cane supplied by such growers. The "point of delivery" referred to above is the point of delivery upon which each of the railage rates specified in clause 3 of Schedule "B" (marginal formula) was calculated.

42. Notwithstanding clause 40, no cane duly returned by the Mill Group Board in accordance with Schedule "C" shall be paid for and it shall be excluded from the growers' quota.

43. Nothing herein contained shall preclude Natal Estates, Tongaat and the Central Factory granting to their growers privileges in relation to cane prices similar to those hitherto enjoyed by them.

44. Doornkop, Entumeni, Shire and Glendale, which receive the concessions set out in clause 58 hereof, shall be exempt from payment to the Equalisation Fund and their suppliers be excluded from the benefits thereof. Doornkop, Entumeni and Shire, however, undertake to pay their European suppliers not less than the Industry price calculated on the marginal formula with payments added thereto, equivalent to the amount they would have received if not excluded as aforesaid. No supplier to such mills shall be entitled to claim any additional payment or benefit to that provided for in clause 40 and this clause, by reason of the concessions granted to such mills by clause 58.

45. Huletts, Zululand Sugar Millers and Planters, and Umzimkulu, which receive guaranteed domestic quotas under clause 59 hereof, and mills producing 10,000 tons or under which receive preferential treatment in respect of export under clause 59, will pay for cane on the basis set out in clause 40 hereof even though by reason of such guaranteed domestic quotas or preferential treatment the export quotas of such mills are reduced, and growers shall not be entitled to claim any additional payment or benefit by reason thereof.

46. In addition to the price specified in clause 40 hereof, there shall be payable to growers in respect of canes other than Uba supplied by them such payments if any, as may be determined by the Central Board, and in regard to such determination it is agreed :—

(*i*) The Central Board shall determine the additional value, if any, to mills of such canes within twelve months from the 1st of May, 1936, and growers shall receive payment in accordance with the additional value so determined as from such date.

(*ii*) For the purpose of ascertaining such additional value, if any, the Board shall cause investigations and tests to be made at such mills as the Board may think necessary during the said period of twelve months.

(*iii*) The Board shall be entitled to require mills to keep and exhibit to it such records as the Board may consider necessary to assist in determining the question.

(*iv*) The Board shall be entitled at the request of either the Natal Sugar Millers Association or the South African Cane Growers' Association to revise any determination at any time not less than two years after the date from which it has become operative.

(*v*) Any determination by the Central Board under the provisions of this clause shall be in pursuance of a unanimous decision. If the Board is unable to come to a unanimous decision it shall (by a majority, if need be) refer the determination to an adjudicator, who shall be an advocate of the Supreme Court of South Africa of at least seven years' standing and whose decision shall be final.

(*vi*) The basis upon which any determination or award is to be made under this section shall be in the discretion of the Central Board or the adjudicator, as the case may be, and they may differentiate as regards class, nature, quality or condition of such canes.

47. Payment to growers due under the provisions of clause 40 (*a*) hereof shall be made as to 90 per cent of its value (which is provisional pending the final determination of base price 96° cargo sugar and the grower's seasonal average sucrose) thirty days after the last day of the month in which the cane is delivered and as to the balance of its value by means of a provisional final payment on 30th April in each year and a final payment so soon as possible thereafter, such balance to carry interest at the rate of 6 per cent per annum.

Payments to European growers due under the provision of clause 40 (*b*) hereof shall be paid in accordance with the provisions of the Schedule "D" therein referred to.

48. Growers shall have the right to participate in filter press cake residual from milling process in accordance with such arrangements as may be made in that behalf between individual mills and their respective Mill Group Boards, and failing such arrangements as may be decided by the Central Board. If millers should load, rail or deliver such cake, the cost of such service shall be paid by growers, and delivery shall be in accordance with arrangements to be made to suit the convenience of the parties.

49. Growers shall have the right to participate in any profit that may accrue to millers by reason of any product residual from the milling process becoming valuable as a source of raw material for any product. The extent of such profit and the proportion thereof that shall accrue to growers shall be determined by the Central Board on the request of any party interested.

No such determination shall be requested or made in respect of molasses until such time as the price of molasses, f.o.r., mill, exceeds ·625d. per gallon, and then only in respect of any such excess and nothing in this clause contained shall apply to the use of bagasse as fuel.

50. (*i*) A full independent cane-testing service shall be maintained in every mill where such service is desired by the growers. Where a majority of 70 per cent of supplying growers do not require a full service, such other arrangements as may be required may be made by the millers and growers concerned.

(*ii*) The cane-testing service shall come under the control of the Central Board. The Millers' Association and Growers' Association shall at all times have access to the data in possession of the Central Board.

(*iii*) The service shall be financed by a levy on sugar, which shall be deducted and paid to the Board by each milling company where the service is in operation. Such levy shall be assessed annually and shall be a first charge against realised proceeds and deductable for the purpose of calculating growers' payments.

(*iv*) The technical manager in charge of the service shall be employed by the Central Board, and the cost of management expenses to be met out of the funds of the Board.

(*v*) Accommodation for chemists and testers satisfactory to the Board shall be supplied by milling companies; the rent therefor shall be part of the cost of the service and shall be assessed by the Central Board.

51. The Central Board shall appoint a technical advisory committee for the purpose of investigating any matter which may be referred to such committee by the Board.

52. Existing cane supply agreements shall be suspended during the operation of this Agreement in so far as they are inconsistent with the provisions hereof, but otherwise they shall remain of full force and effect.

CHAPTER IV.—SOUTH AFRICAN SUGAR ASSOCIATION AND DISPOSAL OF CROP

53. It is agreed that the South African Sugar Association shall be reconstituted in accordance with the provisions of Schedule "E" to this Agreement, which schedule shall supersede the present constitution of the said Association.

54. Whereas in the past the majority of millers have in the interests of the Industry as a whole subjected themselves to the obligation to export proportionately the surplus of sugar manufactured in excess of the requirements of the South African market, which has been sold through the Crop Disposal Committee of the South African Sugar Association ; the proceeds thereof having been equalised and distributed to mills accordingly ; and whereas such majority have also subjected themselves to various levies imposed upon sugar by such Crop Disposal Committee to meet expenditure incurred or rebates granted in respect of manufacturers, coastal freight obligations, the experimental station, propaganda, disposal expenses, and administration, including bank interest, discounting, and other charges of or incidental to the realisation of sugar for local consumption or incidental to the realisation of sugar for local consumption or export, and the financing thereof, or the other operations of such committee, and in respect of other matters affecting the Industry generally, and whereas the growers supplying such mills have indirectly borne their share of the obligations aforesaid ; now therefore it is agreed that save as specifically otherwise herein provided, such obligations and any other similar or cognate obligations approved by the Council of the Sugar Association shall be and become binding upon all refiners and millers (and through them all growers) and shall be known as Industry obligations.

Such similar or cognate obligations shall include any expenditure for which a general levy is provided for in this Agreement, and such other expenditure as the Council aforesaid shall deem to have been or to be necessary in respect of the preparation of this Agreement, the promotion of legislation to secure its being given statutory effect, and its due and effective carrying out during the period of its operation.

The burden of all such Industry obligations shall, save as is otherwise herein specifically provided, be borne rateably by all millers (and through them all growers), the intent and meaning of these presents being that the incidence of such obligations shall be determined upon the basis of proportionate participation therein by the whole Industry and not fall only upon a majority of its members.

55. Millers agree that they will export year by year their respective quotas of sugar manufactured in the Union which is in excess of the requirements of the South African market.

For the purposes of this clause the South African market shall mean and include the Union of South Africa, South West Africa, Swaziland, Basutoland and Bechuanaland.

56. The quantity of the sugar to be exported in each year and each mill's quota of that quantity shall be determined in accordance with the revised constitution of the South African Sugar Association and the provisions of this Agreement.

57. The export obligations undertaken by each miller hereunder shall be enforceable against him by the Council of the Sugar Association, and the remedy for any breach thereof shall be by way of specific performance or damages or both.

Such damages shall be recoverable in the name of the said Council, but for the benefit of the millers who have fulfilled their obligations, and the measure shall be the loss and damage suffered by such millers by reason of the breach. The net amount of any damages recovered by the said Council after deduction of all expenses incurred shall be divided among the millers concerned in such proportions as the Council shall decide.

It is specially agreed that the mere award of damages will not adequately compensate such millers and upon any breach the defaulting miller hereby expressly and irrevocably agrees to submit to an order for specific performance at the suit of the said Council.

58. The following special concessions in regard to export shall be given effect to—

(*i*) *Umfolozi* shall have a minimum quota for sale locally of 12,000 tons but shall export 80 per cent of output in excess of 12,000 tons, provided that its quota of export shall not exceed that of non-concession mills.

(*ii*) *Doornkop* shall be exempt from export until 30th April, 1938, and thereafter shall have a minimum quota for sale locally of 7,000 tons and shall export all output in excess of 7,000 tons.

(*iii*) *Entumeni* shall be exempt from export until 30th April, 1937, and thereafter shall have a minimum quota for sale locally of 2,000 tons and shall export 1 per cent of its total output for every 40 tons produced in excess of 2,000 tons.

(*iv*) *Shire* shall be exempt from export until 30th April, 1937, and thereafter shall have a minimum quota for sale locally of 1,250 tons and shall export 50 per cent of output in excess of 1,250 tons, provided that its quota of export shall not exceed that of non-concession mills.

(*v*) *Glendale* shall be exempt from export until 30th April, 1937, and thereafter shall have a minimum quota for sale locally of 1,550 tons and shall export 50 per cent of output in excess of 1,550 tons provided that its quota of export shall not exceed that of non-concession mills.

59. Other mills shall export the remaining quantity to be exported, after deduction of the quantities to be exported, by the aforementioned concession mills, and each mill's quota of that quantity shall be the proportion in tons which its output bears to the total output of all such other mills. Provided that no mill producing 10,000 tons or under shall be required to export more than 50 per cent of its output

and that the following quotas for sale locally shall be guaranteed to the undermentioned millers, *viz.* :—

	Tons
Huletts	45,000
Zululand S. M. & P.	15,000
Umzimkulu	4,000

Any necessary adjustments in export quotas shall be made to give effect hereto.

60. In respect of sales of sugar locally the undermentioned millers agree to supply in each season cargo sugar to Hulsar for local refining and additional to Hulsar's present sources of supply in the undermentioned quantities, *viz.* :—

	Tons
Smith Group	10,000
Umfolozi—Total output for sale locally.	
Doornkop—After 30th April, 1938	7,000

at a price calculated in the manner provided for in existing supplying millers' agreements with Hulsar :

Provided that :—

(*a*) For purposes of quota and export obligations the quantity of 10,000 tons supplied by the Smith Group shall be deemed to represent an output by that Group of 9,600 tons only.

(*b*) The refined sugar output from the cargo sugar delivered by the Smith Group to Hulsar shall be invoiced f.o.r. refinery on monthly terms to C. G. Smith & Co., Ltd., acting as agents for principals. The quantity of refined sugar to be invoiced in each month in accordance herewith shall be that quantity which is recovered from the cargo sugar delivered by the Smith Group during such month. The use of trade brands in respect of such sugar shall be a matter for arrangement between Hulsars and the mill supplying cargo sugar.

(*c*) Huletts agree to sell to mills which belong to the Smith Group and which supply cargo sugar to Hulsar as aforesaid and the said mills agree to buy shares at par in Refiners Investment (Pty.), Ltd., to an extent sufficient to reduce Huletts holding in the said company to 49·9 per cent of the capital and agree to take all such steps as may be necessary to procure for a nominee of such Group a seat upon the Board of Hulsar. It is hereby recorded that approximately 20,000 shares will be required to be taken up from Huletts to reduce their holding as aforesaid.

(*d*) Payment for all sugar to be supplied by Doornkop to Hulsar in terms hereof shall be made on the 25th of the month following delivery.

(*e*) The Smith Group agree to offer to Doornkop within one month after the first delivery by Doornkop of sugar to Hulsar the right to take up so

many shares at par in the said Refineries Investments (Pty.), Ltd., out of the shares referred to in sub-section (*c*) hereof as will make the ratio of Doornkop's holding thereof to the Smith Group's holding as seven is to ten. Such offer shall be accepted or rejected within thirty days of the date thereof.

(*f*) The Natal Estates, Ltd., agrees to the deletion of that portion of clause 9 of its agency agreement with Hulsar which deals with the supply to it of cargo sugar, and agrees to the substitution therefor of the provision that Hulsar shall supply to it annually at cost such quantity of raw sugar up to 7,000 tons as it may require for export purposes out of any cargo sugar that Hulsar may receive from supplying millers other than those who were under agreement with Hulsar at the date of the agency agreement aforesaid, the Zululand Sugar Millers and Planters, Ltd., being recognised as a supplying miller in place of the Zululand Sugar Milling Co., Ltd. Such substitution shall, notwithstanding the period of this agreement, operate for the remaining period of the said agency agreement.

(*g*) Existing agreements between Hulsar and supplying mills are not hereby affected.

61. The existing Export and Crop Disposal Committee Agreements between millers are superseded by the provisions of this Agreement. Any mill aggrieved by any determination in regard to export quota may appeal to the Central Board whose decision shall be final.

62. Millers and growers agree that Industry obligations other than the obligation to export any surplus, shall be met by means of a levy or levies imposed upon sugar from time to time by the Council of the South African Sugar Association in terms of the powers conferred upon it under the constitution of such Association.

63. Such levies shall be made upon all refiners and millers upon and *pro rata* to output, and for the purposes of this clause "output" is defined as follows :—

(*a*) Output in relation to a refinery shall mean the tonnage of refined sugar of its manufacture sold by it, together with the tonnage of other sugar acquired and sold by it, under deduction in each case of the tonnage sold for any purpose other than consumption in South Africa.

(*b*) Output in relation to a Mill shall mean the tonnage of sugar of its own manufacture sold by it, under deduction of—

(*i*) the tonnage thereof sold to a refinery;

(*ii*) the tonnage thereof exported to fulfil its export quota;

(*iii*) the tonnage thereof sold for consumption outside South Africa.

(*c*) It is understood that the tonnage sold by one mill to another mill to enable the latter to fulfil its export quota is not deducted by the former.

(*d*) When one mill purchases sugar to enable it to fulfil its export quota, and exports it, then if that sugar is included in the output of any other

and that the following quotas for sale locally shall be guaranteed to the undermentioned millers, *viz.* :—

	Tons
Huletts	45,000
Zululand S. M. & P.	15,000
Umzimkulu	4,000

Any necessary adjustments in export quotas shall be made to give effect hereto.

60. In respect of sales of sugar locally the undermentioned millers agree to supply in each season cargo sugar to Hulsar for local refining and additional to Hulsar's present sources of supply in the undermentioned quantities, *viz.* :—

	Tons
Smith Group	10,000
Umfolozi—Total output for sale locally.	
Doornkop—After 30th April, 1938	7,000

at a price calculated in the manner provided for in existing supplying millers' agreements with Hulsar :

Provided that :—

(*a*) For purposes of quota and export obligations the quantity of 10,000 tons supplied by the Smith Group shall be deemed to represent an output by that Group of 9,600 tons only.

(*b*) The refined sugar output from the cargo sugar delivered by the Smith Group to Hulsar shall be invoiced f.o.r. refinery on monthly terms to C. G. Smith & Co., Ltd., acting as agents for principals. The quantity of refined sugar to be invoiced in each month in accordance herewith shall be that quantity which is recovered from the cargo sugar delivered by the Smith Group during such month. The use of trade brands in respect of such sugar shall be a matter for arrangement between Hulsars and the mill supplying cargo sugar.

(*c*) Huletts agree to sell to mills which belong to the Smith Group and which supply cargo sugar to Hulsar as aforesaid and the said mills agree to buy shares at par in Refiners Investment (Pty.), Ltd., to an extent sufficient to reduce Huletts holding in the said company to 49·9 per cent of the capital and agree to take all such steps as may be necessary to procure for a nominee of such Group a seat upon the Board of Hulsar. It is hereby recorded that approximately 20,000 shares will be required to be taken up from Huletts to reduce their holding as aforesaid.

(*d*) Payment for all sugar to be supplied by Doornkop to Hulsar in terms hereof shall be made on the 25th of the month following delivery.

(*e*) The Smith Group agree to offer to Doornkop within one month after the first delivery by Doornkop of sugar to Hulsar the right to take up so

many shares at par in the said Refineries Investments (Pty.), Ltd., out of the shares referred to in sub-section (*c*) hereof as will make the ratio of Doornkop's holding thereof to the Smith Group's holding as seven is to ten. Such offer shall be accepted or rejected within thirty days of the date thereof.

(*f*) The Natal Estates, Ltd., agrees to the deletion of that portion of clause 9 of its agency agreement with Hulsar which deals with the supply to it of cargo sugar, and agrees to the substitution therefor of the provision that Hulsar shall supply to it annually at cost such quantity of raw sugar up to 7,000 tons as it may require for export purposes out of any cargo sugar that Hulsar may receive from supplying millers other than those who were under agreement with Hulsar at the date of the agency agreement aforesaid, the Zululand Sugar Millers and Planters, Ltd., being recognised as a supplying miller in place of the Zululand Sugar Milling Co., Ltd. Such substitution shall, notwithstanding the period of this agreement, operate for the remaining period of the said agency agreement.

(*g*) Existing agreements between Hulsar and supplying mills are not hereby affected.

61. The existing Export and Crop Disposal Committee Agreements between millers are superseded by the provisions of this Agreement. Any mill aggrieved by any determination in regard to export quota may appeal to the Central Board whose decision shall be final.

62. Millers and growers agree that Industry obligations other than the obligation to export any surplus, shall be met by means of a levy or levies imposed upon sugar from time to time by the Council of the South African Sugar Association in terms of the powers conferred upon it under the constitution of such Association.

63. Such levies shall be made upon all refiners and millers upon and *pro rata* to output, and for the purposes of this clause " output " is defined as follows :—

(*a*) Output in relation to a refinery shall mean the tonnage of refined sugar of its manufacture sold by it, together with the tonnage of other sugar acquired and sold by it, under deduction in each case of the tonnage sold for any purpose other than consumption in South Africa.

(*b*) Output in relation to a Mill shall mean the tonnage of sugar of its own manufacture sold by it, under deduction of—

(*i*) the tonnage thereof sold to a refinery ;

(*ii*) the tonnage thereof exported to fulfil its export quota ;

(*iii*) the tonnage thereof sold for consumption outside South Africa.

(*c*) It is understood that the tonnage sold by one mill to another mill to enable the latter to fulfil its export quota is not deducted by the former.

(*d*) When one mill purchases sugar to enable it to fulfil its export quota, and exports it, then if that sugar is included in the output of any other

mill or of a refinery, the purchasing mill shall upon export be entitled to a refund from the levying authority of any levy paid or payable thereon by such other mill or refinery.

(e) In this definition of "output" the words "South Africa" shall mean and include the territories mentioned in clause 55.

Such levy or levies shall be a debt due to the Council aforesaid and recoverable at its instance.

64. Notwithstanding the provisions of the Agreement in respect of levies imposed to meet Industry obligations the following temporary exemptions from such levies shall apply, *viz.*—

(*i*) Doornkop shall be exempted from all such levies until 30th April, 1938, but shall be liable in full thereafter.

(*ii*) Entumeni, Shire and Glendale shall be exempted from all such levies until 30th April, 1937, but shall be liable in full thereafter.

65. Notwithstanding anything hereinbefore contained the Umfolozi Co-operative Sugar Planters, Ltd., are parties to and bound by this Agreement solely in respect of the following :—

(*a*) Their quota of production which is to be 25,000 tons under Schedule "A" (subject however to the provisions of clause 19), *plus* 5,000 tons in terms of clause 17 of this Agreement.

(*b*) The quota of their production for sale in the domestic market, which is to be 12,000 tons *plus* 20 per cent of the quantity produced by them in excess of 12,000 tons, subject to the proviso to (c) hereunder.

(*c*) The quantity to be exported by them, which is to be 80 per cent of their output in excess of 12,000 tons, provided that their quota of export shall not exceed that of non-concession mills.

(*d*) The sale of sugar to Hulsar in terms of clause 60 of this Agreement.

(*e*) Levies in respect of Industry obligations in terms of clauses 15, 54, 62 and 63 of this Agreement.

(*f*) Recognition of the Central Board in so far as its functions are laid down by the Sugar Act and not by this Agreement save and in so far as such functions relate to the subject matters hereinbefore in this clause set out, and provided that the provisions of clause 13 thereof shall not apply.

66. This Agreement does not apply to growers who are members of or supply cane to the Umfolozi Co-operative Sugar Planters, Ltd., save in so far as their rights or obligations may be affected by those provisions thereof which are binding upon the said company.

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SCHEDULE "A"

MILL SUGAR QUOTAS

	1 Peak production	2 Quota
	Tons	Tons
Huletts, Darnall	43,032	..
Huletts, Amatikulu	28,375	..
Huletts, Felixton	30,822	..
Delville Estates	2,091	..
	Tons	Tons
Huletts Total	104,320	110,000
Zululand S. M.	29,098	32,000
Umfolozi Co-op	21,028	25,000
J. H. Shire	985	1,250
Entumeni S. M. Co.	2,775	3,000
Provision for Nkwaleni Planters	..	3,000
Natal Estates	55,659	56,000
Tongaat	58,762	58,000
Central Factory	17,888	17,888
Melville	10,013	10,000
New Guelderland	9,270	9,300
Prospecton	3,439	3,500
Doornkop	9,150	10,000
Glendale	700	1,550
Gledhow / Chakas Kraal	35,929	39,000
Illovo	17,851	20,000
Crookes Bros.	14,944	15,500
Reynolds Bros. Sezela Esperanza	51,638	54,000
Umzimkulu	7,056	7,500
	450,505	476,488
Zululand (including Darnall)	158,206	174,250
Natal	292,299	302,238
	450,505	476,488

NOTE.—In terms of the minute of the Main Committee of the Plenary Conference, dated 11th March, 1936, the quota of Gledhow Mill, for purposes of cane quotas, has been fixed by agreement between the parties concerned at 22,300 tons, and the quota of Chakas Kraal Mill at 16,700 tons.

Cane from the Chakas Kraal area hitherto crushed at Gledhow will participate in the Gledhow quota.

Schedule "B"

Marginal Formula

1. The marginal formula is :

$$\frac{\left\{\begin{array}{l}\text{Base price} \\ \quad 96^\circ\text{ cargo—} \\ \quad\text{sugar.}\end{array}\quad\begin{array}{c}\text{Railage} \\ \text{on} \\ \text{sugar.}\end{array}\right\} \times 64\cdot3315}{\frac{100}{76} \times \frac{96}{100} \times 100} = \text{Value of 1 ton sucrose.}$$

$$\text{Value of 1 ton sucrose (ascertained as above)} \times \frac{\text{sucrose content of cane}}{100} = \text{Value of cane}$$

of any sucrose.

Example.—If the base price of sugar = £10 19*s.* and railage = 12/9, the value of cane of 13 per cent sucrose is 13/7·9.

Division of Proceeds.—The value of cane, to be determined by the division of the free-at-mill value of 96° cargo sugar in the proportion of 64·3315 per cent to cane and 35·6685 per cent to sugar.

Note.—These figures represent the proportion of recoverable sugar calculated according to the formula upon which they are based—in practice, mills producing cargo sugar of a higher polarisation than 96° or mills attaining a higher over-all recovery than 76 per cent. will require to devote a correspondingly smaller proportion of the proceeds to the purchase of cane.

The following are the agreed data upon which these proportions were calculated :—

	£ *s.* *d.*
(*a*) Cost of milling one ton cargo sugar	3 14 0
(*b*) Cost of production one ton cane	0 14 0
(*c*) Sucrose per cent cane	13·25 per cent.
(*d*) Over-all recovery	76 per cent.
(*e*) Polarisation of sugar	96°

And the following calculations illustrate how the proportions were arrived at :—

A. *Tons of Cane to 1 Ton of Cargo Sugar*—

$$\frac{100}{13\cdot25} \times \frac{100}{76} \times \frac{96}{100} = 9\cdot5333$$

B. *Cost of Production of a ton of 96° Cargo Sugar*—

	£
Cost of cane 9·5333 × 14*s.*	= 6·67331
Cost of manufacture	= 3·70000
	10·37331

C. *Proportion of Cane Cost to Manufacturing Cost*—

£		
6·67331 =	64·3315	per cent.
3·70000 =	36·6685	„
10·37331 =	100·0000	„

Value of Uba Cane.—For *illustrative purposes* the value of Uba cane according to the marginal formula at sugar prices from £9 to £13 per ton, *plus* payments from Equalisation Fund is shown in the attached schedule. This table is calculated on the free-at-mill value of sugar after deduction of railage taken at 12*s.* 9*d.* per ton, assumed to be the average for the industry. It will be understood that the cane payments by each mill will vary with their railage on sugar.

2. The base price of 96° cargo sugar shall be the average price per ton of 2,000 lb. of the following :—

(1) Cargo sugar of 96° pol. sold for export.

(2) Cargo sugar of 96° pol. sold for local refining.

(3) The grade of sugar prescribed in terms of section *six* (1) (*f*) of the Sugar Act, 1936.

Provided that in ascertaining the total proceeds realised and the total tonnage sold for export and local refining as well as the total proceeds realised and total tonnage sold of the grade of sugar prescribed in terms of section *six* (1) (*f*) of the Sugar Act as aforesaid, there shall be excluded the proceeds and tonnages of the mills to which special concessions as to export are granted under clause 58 of the Agreement, and provided further that there shall be excluded the proceeds and tonnages of such of the bills to which preferential domestic quotas are granted under clause 59 of the Agreement, as shall during the year aforesaid have received any benefit, preference or adjustment in terms of the said clause.

In calculating such average price the following conditions shall apply, namely :—

(*a*) (*i*) All sugar sold for local consumption (other than that excluded as aforesaid and the special grade of sugar required in terms of the Sugar Act), whether to the refinery or elsewhere, shall be regarded as cargo sugar of 96° pol. sold for local refining at the local refining price.

(*ii*) The local refining price shall be the average price per ton at Hulsar Refinery of Hulsar First Refined sugar for local consumption sold in the seasonal year 1st May to 30th April after deduction of excise, the levies referred to in paragraph 62 of the Agreement, and £4 per ton refining margin. First refined sugar shall mean Hulsar No. 1 and "B" refined sugars and shall not include castor, icing or tablet sugars. Such average price shall be ascertained by dividing the total proceeds realised at the refinery by the total tonnage so sold. The extra cost of packings other than the standard 100-lb. packets shall not be a charge against the price referred to above.

(*b*) (*i*) The export price shall be the average price per ton of all cargo sugar exported (basis 96° pol.) which shall be ascertained by dividing the total

proceeds realised f.a.s. (upon the basis aforesaid) by the total tonnage delivered f.a.s.

(*ii*) The price of the grade of sugar prescribed in terms of section *six* (1) (*f*) of the Sugar Act, 1936, shall be the average price per ton of all such sugar sold after deduction of excise, the levies referred to in paragraph 62 of the Agreement, and such amount as represents its value above that of sugar of 96° polarisation, and after deduction or addition as the case may be of an amount representing any additional cost of storage (including insurance) and marketing (including financing), but not of manufacture nor packing. and any saving in railage that may be occasioned by reason of the application of through rates in respect of such sugar.

Such average price shall be ascertained by dividing the total net proceeds realised f.o.r. Durban by the total tonnage sold.

The excess value of such sugar above that of 96° polarisation shall be determined at the rate of 1·375 per cent of the average price for each degree by which the degree of polarisation of such sugar exceeds 96°, fractions of a degree corrected to the nearest tenth, in proportion.

In the event of any question or dispute arising under this clause, clause 13 of the Agreement shall apply.

(*c*) In the clause "the refinery" shall mean Hulett's South African Refinery at Rossburgh, "sold for local refining" shall mean sold to such refinery for the purpose of being refined thereat, and "for local consumption" shall mean for consumption in the territories set out in clause 55 of this Agreement.

(*d*) In calculating the average price, the practice adopted during the currency of the Fahey Conference Agreement shall be followed in respect of any matter not herein specifically provided for.

(*e*) It is understood and agreed that as the basis 96° polarisation prices realised for all export sugars throughout the season are equalised by means of an Export Equalisation Account so that all exporting mills receive an average and not an individual price, the "proceeds" above referred to as excluded in so far as they relate to such sugars shall be taken to be such average.

(*f*) Any sugar unsold as at the 30th April of each year shall be purchased by the Crop Disposal Committee on and as at that date in order that the total output of each season may be regarded as sold during that season and the season's base price of 96° cargo sugar truly determined with the least possible delay.

The purchase price shall be on the basis of the average price realised for similar quality of sugar during the seasonal year from 1st May to 30th April.

The committee shall proceed to realise on behalf of the Industry such sugars in their discretion to the best advantage.

3. (*a*) Railage on sugar means railage per ton paid on sugar between the mill at which the grower's cane was crushed during the 1935/36 season and the point of delivery.

(*b*) For the purpose of the marginal formula the following shall be deemed to be the railage in question, namely :—

Mill	Railage s.	Railage d.	Point of delivery
Empangeni	19	0	(Refinery and Point).
Felixton	19	0	Ditto.
Amatikulu	16	11	Ditto.
Darnall	13	7	Ditto.
Delville	18	6	Ditto.
Gledhow	12	0	(Maydon Wharf).
Chaka's Kraal	10	4	Ditto.
Renishaw	10	4	Ditto.
Sezela	12	0	Ditto.
Esperanza	12	0	Ditto.
Tongaat	8	7	(Refinery and Point).
Mount Edgecombe	5	3	(Point and Maydon Wharf).
New Guelderland	12	9	(Refinery and Point).
Melville	11	11	(Point and Durban).
Doornkop	13	8	Ditto.
Central Factory	6	11	(Refinery and Point).
Illovo	6	11	(Maydon Wharf).
Prospecton	4	5	(Refinery and Point).
Umzimkulu	15	2	(Maydon Wharf).
Entumeni	23	4	(Point and Durban).

(*c*) Notwithstanding the foregoing :—

(*i*) the railage in respect of Fort Pearson growers supplying the Central Factory shall be the Central Factory rate above set out ;

(*ii*) the railage in respect of growers supplying cane to Huletts in Zululand which is sent out of Zululand by Huletts to Darnell Mill shall be the Amatikulu rate above set out.

4. The base price of sugar shall be estimated by the Council of the Sugar Association at the commencement of each season and thereafter monthly during the season for the purpose of enabling provisional payments to be made to growers in accordance with the provisions of clause 47 of the Agreement.

It shall be provisionally determined in respect of each season by the said Council not later than the 30th of April in each year for season then past, and shall be finally determined for such season by the said Council upon the completion of the Export Equalisation Accounts hereinbefore referred to.

Schedule of Cane values for Uba Cane of 13 per cent sucrose based on marginal formula after deduction of assumed

Price of Sugar		Marginal Formula *plus* Equalisation Flat Rate of 10*d.* per ton	Marginal Formula.	Graded Payments				
Durban.	Free-at-Mill			15,000	14,000	13,000	12,000	11,000
£ *s.* *d.*	£							
9 0 0	8·3625	11/10·9	11/0·9	11/0·9	11/2·2	11/3·5	11/4·9	11/6·2
9 10 0	8·8625	12/6·8	11/8·8	11/8·8	11/10·2	11/11·5	12/0·8	12/2·2
10 0 0	9·3625	13/2·8	12/4·8	12/4·8	12/6·1	12/7·4	12/8·8	12/10·1
10 10 0	9·8625	13/10·7	13/0·7	13/0·7	13/2·0	13/3·4	13/4·7	13/6·0
11 0 0	10·3625	14/6·7	13/8·7	13/8·7	13/10·0	13/11·3	14/0·7	14/2·0
11 10 0	10·8625	15/2·6	14/4·6	14/4·6	14/5·9	14/7·3	14/8·6	14/9·9
12 0 0	11·3625	15/10·5	15/0·5	15/0·5	15/1·9	15/3·2	15/4·5	15/5·9
12 10 0	11·8625	16/6·5	15/8·5	15/8·5	15/9·8	15/11·2	16/0·5	16/1·8
13 0 0	12·3625	17/2·4	16/4·4	16/4·4	16/5·8	16/7·1	16/8·4	16/9·8

plus *graded payments from Equalisation Fund, calculated on free-at-mill value of sugar average railage,* i.e., *12*s. *9*d.

according to Output (Tons)

10,000	9,000	8,000	7,000	6,000	5,000	4,000	3,000	2,000	1,000
11/7·5	11/8·9	11/10·2	11/11·5	12/0·9	12/2·2	12/3·5	12/4·9	12/6·2	12/7·5
12/3·5	12/4·8	12/6·2	12/7·5	12/8·8	12/10·2	12/11·5	13/0·8	13/2·2	13/3·5
12/11·4	13/0·8	13/2·1	13/3·4	13/4·8	13/6·1	13/7·4	13/8·8	13/10·1	13/11·4
13/7·4	13/8·7	13/10·0	13/11·4	14/0·7	14/2·0	14/3·4	14/4·7	14/6·0	14/7·4
14/3·3	14/4·7	14/6·0	14/7·3	14/8·7	14/10·0	14/11·3	15/0·7	15/2·0	15/3·3
14/11·3	15/0·6	15/1·9	15/3·3	15/4·6	15/5·9	15/7·3	15/8·6	15/9 9	15/11·3
15/7·2	15/8·5	15/9·9	15/11·2	16/0·5	16/1·9	16/3·2	16/4·5	16/5·9	16/7·2
16/3 2	16/4·5	16/5·8	16/7·2	16/8·5	16/9·8	16/11·2	17/0·5	17/1·8	17/3·2
16/11·1	17/0·4	17/1·8	17/3·1	17/4·4	17/5·8	17/7·1	17/8·5	17/9·8	17/11·1

Sucrose scale Uba Cane

Marginal Formula plus *Equalisation Flat Rate of* 10d. *per Ton.*

Sucrose % Cane. / Price of Sugar £ s. d.	9%	9·5%	10%	10·5%	11%	11·5%	12%	12·5%	13%	13·5%	14%	14·5%	15%
9 0 0	8/6·0	8/11·1	9/4·2	9/9·3	10/2·4	10/7·5	11/0·6	11/5·8	11/10·9	12/4·0	12/9·1	13/2·2	13/7·3
9 10 0	8/11·5	9/4·9	9/10·3	10/3·7	10/9·2	11/2·6	11/8·0	12/1·4	12/6·8	13/0·2	13/5·6	13/11·1	14/4·5
10 0 0	9/5·0	9/10·7	10/4·4	10/10·2	11/3·9	11/9·6	12/3·3	12/9·0	13/2·8	13/8·5	14/2·2	14/7·9	15/1·6
10 10 0	9/10·5	10/4·5	10/10·5	11/4·6	11/10·6	12/4·6	12/10·7	13/4·7	13/10·7	14/4·7	14/10·8	15/4·8	15/10·8
11 0 0	10/4·0	10/10·3	11/4·7	11/11·0	12/5·3	12/11·7	13/6·0	14/0·3	14/6·7	15/1·0	15/7·3	16/1·7	16/8·0
11 10 0	10/9·5	11/4·1	11/10·8	12/5·4	13/0·0	13/6·7	14/1·3	14/8·0	15/2·6	15/9·2	16/3·9	16/10·5	17/5·2
12 0 0	11/3·0	11/9·9	12/4·9	12/11·8	13/6·8	14/1·7	14/8·7	15/3·6	15/10·5	16/5·5	17/0·4	17/7·4	18/2·3
12 10 0	11/8·5	12/3·7	12/11·0	13/6·2	14/1·5	14/8·7	15/4·0	15/11·2	16/6·5	17/1·7	17/9·0	18/4·2	18/11·5
13 0 0	12/2·0	12/9·6	13/5·1	14/0·7	14/8·2	15/3·8	15/11·3	16/6·9	17/2·4	17/10·0	18/5·5	19/1·1	19/8·6

SCHEDULE "C".

CHEMISTS' SCALE

1. *Sampling.*—A sample of crusher juice representing the maximum possible proportion of the cane delivered shall be taken for every consignment of cane crushed, as specified in paragraph 13.

2. *Analyses of Samples.*—The sample of crusher juice shall be tested for pol. as specified in paragraph 10.

3. *Calculation of Sucrose per cent Cane.*—The sucrose per cent cane for each consignment shall be determined from the pol. of the crusher juice by the application of a Java Ratio, determined as under.

4. *Differential Java Ratio.*—Java Ratios for different varieties of cane shall be as follows :—

Co. 290 cane shall have a Java Ratio 2·0 higher than that for dry Uba cane.

P. O. J. 2714, 2725, 2727 and 2878 canes shall have a Java Ratio 4·0 higher than that for dry Uba cane.

In the event of any other variety being crushed, the appropriate Java Ratio shall be decided upon by the Central Board. No addition shall be made to the Java Ratio of Co. 281 or any other newly-released variety until such an addition shall have been agreed to by the Central Board.

This clause is to be subject to modification after 30th April, 1937, so as to bring it into accordance with the determination of the Central Board provided for in clause 46 of the Agreement.

5. *Wet Cane.*—Whenever cane during any period is suffering from the effects of dilution by rain water the testing service chemist and millers' chemist shall ascertain the average sucrose of the previous three consignments and shall add 1·0, 2·0, 3·0 or 4·0 to the Java Ratio of the consignment so affected so as to bring the surcrose percentage to about the average so ascertained, bearing in mind the increased weight of the consignment. Any objection to the procedure in any particular case to be referred to the Central Board.

6. *Condition of Cane.*—Whenever the mill chemist or the testing service chemist considers that continuously after notice cane is being delivered in such a condition that it either detracts from the efficiency of the mill or causes a maldistribution of the sucrose between the mill suppliers, he may refer the matter to the Mill Group Board.

The Mill Group Board may thereupon order the cane to be returned to the sender ; the Board shall not, however, impose the foregoing penalty until at least one warning has been sent to the supplier.

7. *Methods of Calculating Sucrose Balance.*—The average of all Java Ratios applied during any daily or weekly period as provided in paragraphs 4 and 5, shall be such as will indicate a total weight of sucrose in cane equal to the total weight of sucrose entering the factory during the period, as determined by analysis of the mixed juice and the bagasse.

8. *Periodical Adjustments.*—The period for which the correct Java Ratio shall be determined (as in 4) shall normally be one week. It may, however, be done more frequently at any factory by mutual agreement between the factory chemist and the technical manager of the Central Board.

9. *Monthly Statements.*—The Central Board shall report monthly to the Manufacturing Company and to the S. A. Cane Growers' Association the total weight of cane delivered and the total weight of sucrose for each grower who has delivered cane to the mill during the preceding monthly period.

10. *Method of Analysis of Crusher Juice.*—The method of analysis of crusher juice from separate consignments shall be by the use of a Brix Hydrometre and Horne's "dry lead" method of direct polarisation. The Central Board should specify methods to be used in special circumstances when the above method may not be applicable.

11. *General Analyses.*—All other analyses relevant to this Agreement shall be done in accordance with the official methods of the South African Sugar Technologists' Association.

12. *Provisions for Sampling.*—The manufacturing company shall supply the following facilities for the sampling of cane :—

(*a*) A suitable device for obtaining a continuous flow of a representative sample of crusher juice throughout the period of sampling of each and every consignment of cane.

(*b*) Some automatic device for signalling the arrival of the beginning and end of the sampled portion of every consignment of cane at the crusher rolls.

(*c*) A bell or other signal to afford communication between the carrier and the testing service laboratory.

13. *Specification of Crusher Juice Samples.*—The manufacturing company shall provide the necessary facilities to obtain the following samples of consignments :—

Consignments of 15 tons and over	80 per cent.
Consignments between 10 tons and 15 tons	60 per cent.

Every attempt should be made to sample consignments under 10 tons, but where that cannot be done, or when the above samples of larger consignments cannot be obtained, then the analysis of the last previous, or failing that the next following, sample of cane of a similar type crushed under similar conditions shall apply.

14. *Weighing of Cane Juice and Water.*—The manufacturing company shall provide the following facilities for the determination of total sucrose in cane :—

(*a*) Weighing scales for juice and scales or meters for water of a type approved by the Government Assize Department.

(*b*) Automatic devices which record the filling and emptying of each scale tank (such as the "Bristol" Recorder or the like).

(*c*) Sequence-numbered tickets to be used in connection with all weighbridges and juice and water scales. These tickets are to be used but once and to be available at any time to the testing service chemist.

(*d*) All juice and water scales should be provided with automatic counters recording the number of tanks weighed.

(*e*) Only weighed or metered water to be allowed to enter mixed juice.

15. *Steam Injector Pumps.*—Steam injectors shall not be used for pumping unweighed juice, unless agreed to by the Central Board, who should in such cases specify the necessary correction to be applied.

16. *Amendments and Additions.*—Any amendments or additions to the provisions of paragraphs 4, 10, 12 and 14 are to be determined by the Central Board, duly advised by a Technical Advisory Committee.

17. *Availability of Records.*—The testing service chemist and the millers' chemist will render accessible to each other all books and records which are in any way relevant to the testing of cane and the distribution of cane value.

Schedule "D"

The Equalisation Fund

1. There shall be established under the administration of the South African Cane Growers' Association a fund to be called the "Equalisation Fund" for the purpose of enabling payments to be made to European Growers in pursuance of the provision of clause 40 (*b*) of the Agreement.

2. (*a*) The undermentioned mills agree to contribute to the said Fund in each milling season the amounts specified hereunder, *viz.*:—

	£
Empangeni	Nil
Felixton	Nil
Delville	Nil
Amatikulu	Nil
Darnall	2,000
Gledhow and Chaka's Kraal	6,500
Illovo	3,000
Crookes Bros.	2,000
Reynolds Bros.	10,500
Umzimkulu	500
New Guelderland	500
Tongaat	11,000
Central Factory	2,000
Natal Estates	12,000
Prospecton	500
Melville	500
	£51,000

and Huletts agree, in addition, to contribute a further sum up to £500 to enable payment to be made from the Fund to Felixton Mill of the additional amount paid by it to growers in consequence of the use in the marginal formula in respect of cane supplied to it of 19*s.* railage instead of actual railage.

(*b*) Millers—other than the Export concession Millers specified in clause 58 of the Agreement—agree to pay to the Equalisation Fund a levy of 1½*d.* per ton upon all cane crushed by them which is supplied by European growers or owned by such millers, and an additional levy of 1½*d.* per ton upon all cane crushed by such millers and owned by

them. Cane owned by such millers includes cane owned by subsidiary companies in which such millers owned more than 52½ per cent of the capital on the 23rd March, 1936.

3. (*a*) Payment of miller's contributions as set out in clause 2 (*a*) hereof shall be made to the South African Cane Growers' Association in seven equal monthly instalments payable on 20th June and thereafter on the 20th day of each of the next succeeding six months.

(*b*) Payment by millers of the levies as set out in clause 2 (*b*) hereof shall be made to the South African Cane Growers' Association on the 20th day of each month in respect of cane crushed during the preceding month.

(*c*) Contributions and levies as aforesaid shall be deemed to be debts due by millers to the said Association, and shall be recoverable at the suit of the said Association.

4. The South African Cane Growers' Association shall receive the contributions and levies as aforesaid and shall bank the same in a special banking account to be designated the "Equalisation Fund Account", and shall pay therefrom :—

(*a*) Payments to European growers other than those supplying the Export Concession Mills specified in clause 58 of the Agreement in each session in respect of the price of cane supplied by them to millers in accordance with the following formula, *viz.* :—

$\frac{15,000-Y}{7,500} \times 10d.$ per ton of cane,

where Y represents the tons of cane supplied by a grower during such season. For the purpose of this clause "tons of cane supplied by a grower" shall be defined by the Central Board.

(*b*) To Felixton Mill the additional amount paid by it to growers in any season in consequence of the use in the marginal formula in respect of cane supplied to it of 19*s*. railage instead of actual railage.

5. (*a*) Payment to European growers under the provisions of clause 4 (*a*) hereof shall be made by the said Association in respect of cane supplied during any month as to 90 per cent calculated on the basis of estimates supplied during the season, within 35 days of the last day of the month in which the cane is delivered, and as to the balance on 30th April in each year.

(*b*) Payment to Felixton Mill under the provisions of clause 4 (*b*) hereof shall be made by the said Association on 30th April in each year in respect of the crop year then ending.

6. Should the application during a season of the formula set out in clause 4(*a*) hereof result in a shortfall or surplus in the Equalisation Fund, such shortfall or surplus shall be adjusted in that season by decreasing or increasing the factor of 10*d*. in the formula.

7. The expenses of administering the Fund shall be borne by the Fund.

Supplement relating to non-European Equalisation.

8. Any non-European Board established pursuant to clause 24 of the Agreement may, provided it shall first have obtained the approval and consent thereto of the Central Board, create a fund for the assistance of small non-European suppliers of the mill by means of a levy of 1½*d*. per ton on cane supplied to the mill by non-European suppliers which levy shall be deducted from the price payable for such

cane by the miller. If any such fund is so created the miller shall contribute to it an equivalent amount of 1½*d.* per ton on non-European cane. Such fund shall be distributed by the miller among small non-European suppliers of the will as the Poard shall determine.

Schedule "E".

Constitution of the South African Sugar Association.

1. *Name and Registrered Office.*—(*a*) *Name.*—The name of the Association shall be the "South African Sugar Association".

(*b*) *Registered Office.*—The registered office of the Association shall be situated in Durban.

2. *Membership and Representation.*—(*a*) *Membership.*—The members of the Association shall be the Natal Sugar Millers' Association and the South African Cane Growers' Association. They are hereinafter referred to as the Millers' Section and Growers' Section respectively.

(*b*) *Representation.*—Each Section shall be represented in the Association by 18 delegates appointed by it. In addition Hulett's South African Refineries, Ltd., shall have one representative, who shall, however, not be entitled to a vote at meetings of the Association.

3. *Objects*—The objects for which the Association is established are:—

(*a*) To promote, foster and regulate the production of sugar cane and the manufacture of cane sugar;

(*b*) To represent the views of the cane sugar industry to Parliament, Government and to the Public bodies and officials in the Union of South Africa, and elsewhere, as may be necessary.

No member shall approach or make representations to the Union Government or any Government Department or Parliament on any matter affecting, or of general interest to, the Sugar Industry without first giving the Association ten days' written notice of its intention so to do.

(*c*) To promote reciprocal and/or preferential arrangements as to duties and tariffs, with the object of fostering, stimulating and regulating the promotion of cane sugar in South Africa.

(*d*) To collect and circulate statistics and other information on all matters of interest to the Sugar Industry.

(*e*) To take steps for the improvement of the technical knowledge of persons engaged in the Sugar Industry.

(*f*) To deal with questions relating to labour.

(*g*) To take such steps as may be considered desirable to increase the consumption of South African cane sugar, and to ensure that it will reach the consumer through the most direct and economical channel.

(*h*) To provide machinery for examining and adjusting major grievances amongst sections of the Industry.

(*i*) To establish an experiment station or experiment stations from time to time, and for that purpose to raise such loans with or without security for such amounts, and at such rates of interest and subject to such terms as to repayment of principal as may from time to time be necessary. To acquire, deal with, and dispose of property both movable and immovable. To maintain out of revenue any station or stations so established.

(*j*) To exercise all such powers as are hereinafter conferred upon the Council of the Association or any committee thereof.

(*k*) To do all such things as are in the opinion of the Association necessary, proper, or advisable, for the advancement generally of the Industry, or which are incidental or conducive to the attainment of all or any of the above objects.

4. *Finance.*—(*a*) The funds of the Association shall be banked in the name of the "South African Sugar Association" at such bank as the Council may direct. Every sum above 10*s*. paid on behalf of the Association shall be paid by cheque signed by any one member of the executive committee and countersigned by the Secretary.

(*b*) Auditors shall be elected at the ordinary meeting in each year and their remuneration shall be fixed at such meeting for the past year's audit. Auditors shall be eligible for re-election, but no delegate shall be eligible as an auditor. The auditors shall have the right of access at all times to the books and vouchers of the Association and shall be entitled to require from the Council and officers of the Association such information and explanation as may be necessary for the performance of their duties as auditors.

5. *Administration.*—(*a*) An honorary president and honorary vice-president may be elected annually. They need not be delegates nor members of either section.

(*b*) The affairs of the Association shall be administered by a Council consisting of a chairman and fourteen councillors elected annually, of whom seven shall be elected by the delegates of the millers' section from among their number and seven shall be elected by the planters' delegates from among their number. A member of the Council may appoint an alternate with the approval and at the discretion of the Council. Any member failing by himself or his alternate to attend three consecutive meetings without leave of absence from the Council shall vacate office. Casual vacancies shall be filled by the section which appointed the retired councillor.

(*c*) The officers of the Association shall consist of a chairman, vice-chairman and secretary. The chairman shall be elected by the Association for such period and on such terms as remuneration and otherwise as the Association may deem fit.

The vice-chairman shall be elected annually from amongst the councillors.

The secretary shall be appointed in the manner hereinafter provided.

(*d*) Meetings of the Council shall be held as occasion may require, but at least once a quarter. At meetings of the Council six members personally present shall form a quorum provided that they include at least two representatives of each section. If within half an hour from the time appointed for the meeting a quorum is not present, the meeting shall stand adjourned to the same day in the next week at the same time and place, or, if that day be a public holiday, to the next succeeding day other than a

public holiday ; and if at such adjourned meeting a quorum is not present within a quarter of an hour from the time appointed for the meeting the members present shall be a quorum.

(*e*) The Council shall elect an executive committee from its own number, consisting of such number as the Council may decide, and shall also elect such standing committees as may be necessary. The Council shall from time to time determine the duties of the executive committee and the standing committees, and may make rules for their guidance. Committees shall without undue delay report to the Council. All committees shall be subject to the directions and under the control, of the Council. Save as provided in sub-section (*f*) hereto or unless otherwise agreed, both the Growers' Association and the Millers' Association shall be equally represented upon every committee.

(*f*) The Council shall appoint a Committee to be known as the Crop Disposal Committee, the members of which shall retire annually on 30th April in each year, but shall be eligible for reappointment. Until their successors have been appointed they shall continue to act. Such committee shall consist of not less than *ten* nor more than thirteen members, of whom not fewer than seven nor more than nine shall be millers and not fewer than three nor more than four shall be growers. The Crop Disposal Committee shall have and exercise such powers and functions as the Council of the South African Sugar Association may confer upon it from time to time, and shall also have power to appoint, fix the duties and terms of appointment of, remove or suspend at its discretion secretaries, auditors and employees required for the business of the committee.

(*g*) The secretary to the Association shall be appointed on such terms and conditions as the Council may approve.

6. *Meetings.*—(*a*) All meetings of the Association and of the Council shall be presided over by the chairman of the Association and in his absence by the vice-chairman, whom failing by a chairman elected by the meeting.

(*b*) A general meeting shall be held once in every year within two months after the close of the financial year at such time and place as may be fixed by the Council. The business of this meeting shall be to consider the report by the Council on the year's working of the Association and the duly audited balance-sheet and statement of revenue and expenditure for the past year, to appoint auditors and fix their remuneration for the past audit, and to do such other business as it is competent to transact at an annual general meeting. The meeting may also transact any special business.

(*c*) The above meetings shall be called ordinary meetings ; all other meetings shall be called special meetings.

(*d*) The Council may call a special meeting whenever they deem fit, and the chairman shall call a special meeting whenever requested by either section so to do. Particulars of the special business to be transacted at an ordinary meeting, and of the business to be transacted at a special meeting, shall be given in the notice calling the meeting. Not less than seven days nor more than twenty-one days' notice shall be given to all members of every general meeting, provided that the chairman may convene a special meeting on less than seven days' notice in the case of an emergency.

(e) Twenty delegates personally present shall form a quorum for all general meetings. If within half an hour from the time appointed for the meeting a quorum is not present, the meeting shall stand adjourned to the same day in the next week at the same time and place, or, if that day be a public holiday, to the next succeeding day other than a public holiday, and if at such adjourned meeting a quorum is not present within half an hour from the time appointed for the meeting, the members present shall form a quorum.

(f) Any member of either section may attend general or Council meetings by consent of the meeting.

7. *Voting.*—(a) At general meetings each delegate shall be entitled to one vote. All questions arising at any general meeting shall be determined by a majority representing two-thirds of the votes of the delegates present at the meeting, provided that such majority includes votes from both sections. The standing chairman shall not exercise a vote at any meeting. This shall not apply, however, to any delegate who may be appointed to take the chair at any meeting in the absence of the standing chairman.

(b) At all meetings of the Council all questions arising shall be determined by a majority of votes provided such majority includes votes of councillors appointed by both sections. The standing chairman shall not exercise a vote at any meeting. This shall not apply, however, to any delegate who may be appointed to take the chair at any meeting in the absence of the standing chairman.

(c) The proviso to sub-sections (a) and (b) of this clause shall not apply if the meeting be one which has stood adjourned for lack of a quorum. At such adjourned meetings questions shall be determined by the required majority of votes of those present whether the majority includes votes from both sections or not.

8. *Powers of Council.*—Without prejudice to the general power conferred upon the Council by clause 5(b) hereof it shall have and exercise the following powers and functions, namely :—

(a) To control and regulate season by season the disposal of the total output of sugar produced year by year by millers, whether sold in South Africa or overseas, and to determine the quantity of sugar to be exported each year, and each mill's quota of that quantity in accordance with the provisions of any agreement in that behalf existing from time to time.

(b) To determine the base price of sugar in respect of each season at the end thereof, and to estimate such price at the commencement of each season and thereafter monthly during the season for the purpose of enabling payments to be made to growers in accordance with the provisions of any agreement in that behalf existing from time to time.

(c) To incur such expenditure as it may think necessary or desirable in the interests of the Industry in regulating and controlling the disposal of the said sugar, and in carrying out all the powers granted to it hereunder.

(d) To make levies upon output of sugar for the purpose of meeting Industry obligations, it being understood that the terms " output " and " Industry obligations " shall have the meaning assigned to them in any agreement

arrived at between the Natal Sugar Millers' Association and the S. A. Cane Growers' Association which is binding upon all refiners, millers and growers in the Union.

(e) To consider and decide on the persons or classes of persons or trades to whom rebates shall be made to meet the competition of imported sugars or otherwise and to fix the amount or amounts of such rebates.

(f) To decide on the policy to be followed from time to time in connection with the sale of sugar in South Africa and abroad.

(g) To originate, carry on, direct and control propaganda in connection with the sale of sugar in South Africa and abroad.

(h) To open a banking account or accounts in the name of the Association, to determine who shall operate thereon, and if necessary, or desirable in the discretion to obtain advances from such bank or banks to finance the operations of the Council and give such security or securities as may be required by the banks in connection therewith.

(i) To purchase, sell and deal in sugar and its allied products.

(j) To institute, conduct or defend, settle or abandon any legal proceedings and to compromise or submit to arbitration any claims by or against the Association or the Council.

(k) To do all such things as may be incidental to the proper carrying out of the foregoing powers and of the functions hereby entrusted to it.

(l) To delegate all or any of the powers conferred upon it by clause 5(b) and this clause, to any committee referred to in clause 5 ; any decision or act duly arrived at or performed pursuant to any such delegation being deemed to be the decision or act of the Council itself.

(m) The Council shall exercise its powers under the control of the Association in general meeting, but no decision of such general meeting shall affect or invalidate any prior decision or Act of the Council.

9. The Crop Disposal Committee may meet weekly but shall meet at least once in each month for the transaction of its general business. It shall have power to appoint an executive of not less than three members, one of whom shall be a grower, which shall have and be entitled to exercise all the powers of the full committee, subject always to the control of that committee. The first Executive Committee shall be :—

A. W. Dickens, W. E. R. Edwards and a grower.

The Committee may also appoint sub-committees with such powers as it may delegate to them.

With a committee of nine or ten members, six members, with a committee of eleven members, eight members, and with a committee of twelve members, nine members, shall respectively constitute a quorum of the committee, and two members shall constitute a quorum of the executive. Any member failing by himself or his alternate to attend three consecutive meetings without leave of absence from the committee concerned shall vacate office. The vacancy so caused and all casual vacancies

shall be filled by the committee. A member of the committee may appoint an alternate with the approval, and at the discretion of, the committee. All decisions of the committee or its executive shall be valid if passed by a majority of its members.

In the absence of any resolution by the committee to the contrary, all documents to be signed on behalf of the committee shall be sufficiently signed if signed by two members and the secretary.

Each member of the committee or executive shall be entitled to receive such remuneration as the Council may from time to time decide.

10. *Third Parties.*—In the event of the Association, Council, or Crop Disposal Committee refusing or neglecting to make any levy which is required for the purpose of meeting any obligation or liability duly incurred by them to any third party, such party shall be entitled to make application to the court to compel the making of such levy to such extent as may be required in accordance with the powers conferred in this constitution, failing which for an order authorising and directing that such levy shall be made by some person or persons duly appointed thereto and in that behalf by the court, and to that extent the levy provisions of this constitution shall be deemed to be an agreement between the Association and the members thereof for the benefit of such third party, of which such third party may avail himself by making such application as hereinbefore provided. The deletion or alteration of this clause shall not affect any such third party in respect of any liability or obligation incurred prior thereto.

11. *Indemnity.*—Every member of the Council or of any committee appointed by it (and every official of the Association) is hereby indemnified and held harmless by the Association against any personal liability incurred by him arising out of or in connection with the due exercise or performance by the Council or by any such committee of any of the powers and functions which are or may be conferred upon it by or pursuant to these presents. Any liability imposed upon the Association by this clause may be met by means of a levy made under clause 8 and shall for that purpose be deemed to be an Industry obligation.

12. *Alteration of Constitution.*—No alteration of, or addition to, any clause of this constitution shall be made unless decided upon by a vote of a general meeting after 30 days' notice of the proposed alteration or addition has been given in writing.

Personal Notes, Appointments and Transfers, Meetings and Conferences, etc.

The Imperial Council of Agricultural Research

SIR BRYCE BURT, Kt., C.I.E., M.B.E., I.A.S., Agricultural Expert, on return from leave, resumed charge of his duties as Offg. Vice-Chairman, Imperial Council of Agricultural Research, with effect from the 11th December 1936, relieving MR. N. C. MEHTA, I.C.S.

MR. N. C. MEHTA, I.C.S., and MR. BAZLUL KARIM, reverted to their substantive appointments of Secretary, Imperial Council of Agricultural Research and Superintendent, Imperial Council of Agricultural Research Department, respectively, with effect from the 11th December 1936.

SIR JOHN RUSSELL, O.B.E., D.Sc., F.R.S., Director, Rothamsted Experimental Station, Harpenden, Herts, England, has been appointed Expert Scientific Adviser (Crops and Soils) under the Imperial Council of Agricultural Research, with effect from the 4th November 1936.

DR. N. C. WRIGHT, M.A., Ph.D., Director, Hannah Dairy Research Institute, Ayrshire, Scotland, has been appointed Expert Scientific Adviser (Dairying), with effect from the 4th November 1936.

Under Rule I (39) of the Rules and Regulations of the Imperial Council of Agricultural Research the Government of India have nominated MR. C. G. TREVOR, C.I.E., I.F.S., Inspector-General of Forests, to be the representative of the Forest Research Institute, Dehra Dun, on the Imperial Council of Agricultural Research, with effect from the 6th November 1936, *vice* MR. F. CANNING, C.I.E., resigned.

The Imperial Institute of Sugar Technology

The following appointments have been made in the Imperial Institute of Sugar Technology, Cawnpore, with effect from the date shown against each :—

Name	Designation	Date of appointment
1. Mr. C. W. P. Van Der Meyden	Prof. of Sugar Technology.	1st October 1936.
2. Mr. D. G. Walawalkar, B.Ag., M.Sc.	Assistant Prof. of Sugar Chemistry.	13th October 1936.
3. Mr. D. K. Brahma, B.Sc. .	Assistant Prof. of Sugar Engineering.	1st October 1936.
4. Mr. K. C. Joshi . .	Assistant Prof. of Sugar Technology (Officiating).	16th November 1936.
5. Dr. A. N. Rao, M.Sc. (Cal.), D.Sc. (Berlin), A.I.C.	Physical Chemist . .	1st October 1936.
6. Mr. A. R. Khan . . .	Assistant Sugar Technologist.	Ditto.
7. Mr. H. S. Chaturvedi, B.Sc., M.S. (L.A.).	First Assistant to Sugar Technologist.	Ditto.
8. Dr. H. D. Sen, M.Sc., Ph.D. (London), D.I.C.	Bio-Chemist . .	Ditto.
9. Dr. P. V. Sukhatme, Ph.D.	Statistician . .	Ditto.

The Indian Central Cotton Committee

The Governor-General in Council has been pleased to appoint Rai Sahib K. I. Thadani, Officiating Chief Agricultural Officer in Sind, to be a member of the Indian Central Cotton Committee, *vice* Mr. W. J. Jenkins, resigned.

In consequence of the vacancy caused by the resignation of Mr. A. P. Darlow, the Karachi Chamber of Commerce have nominated Mr. G. C. R. Colebridge, to be a member of the Indian Central Cotton Committee.

The Indian Lac Cess Committee

The Governor-General in Council has been pleased to appoint Sir Bryce Burt, Kt., C.I.E., M.B.E., B.Sc., I.A.S., Offg. Vice-Chairman of the Imperial

Council of Agricultural Research to be the President of the Indian Lac Cess Committee and to be the Chairman of its Governing Body and Advisory Board, with effect from the 11th December 1936, *vice* MR. N. C. MEHTA, I.C.S., resigned.

The Governor-General in Council has been pleased to appoint MR. C. G. TREVOR, C.I.E., I.F.S., Inspector-General of Forests, as a member of the Advisory Board of the Indian Lac Cess Committee *vice* MR. F. CANNING, C.I.E., resigned.

The Indian Central Jute Committee

MR. A. P. CLIFF, B.A. (Cantab.), Dip. in Agri. (Cantab.), I.A.S., has been appointed as Secretary, Indian Central Jute Committee, with effect from the 3rd December 1936.

The following persons have been nominated as members of the Indian Central Jute Committee :—

1. VICE-CHAIRMAN, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH (*ex-officio* President).
2. AGRICULTURAL EXPERT TO THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH (*ex-officio* Member).
3. SIR ABDUL HALIM GHUZNAVI, Kt., M.L.A. (nominated by the Governor-General in Council).
4. MR. PADAMPAT SINGHANIA (nominated by the Governor-General in Council).
5. MR. N. BRODIE, M.Sc., F.C.S., A.I.C. (nominated by the Governor-General in Council).
6. DIRECTOR OF AGRICULTURE, BENGAL (representative of the Agricutural Department of the Government of Bengal, nominated by that Government).
7. MR. D. R. SETHI, I.A.S. (representative of the Agricultural Department of the Government of Bihar, nominated by that Government).
8. REGISTRAR OF CO-OPERATIVE SOCIETIES, BENGAL (representative of the Co-operative movement in Bengal, nominated by the Government of Bengal).

Eight persons representing trade interests, viz.—

9. MR. H. H. BURN of Messrs. McLeod & Co. (member elected by the Indian Jute Mills Association).

10. MR. P. S. MACDONALD of Messrs. Thomas Duff & Co. (member elected by the Indian Jute Mills Association).
11. MR. H. A. LUKE of Messrs. Haworth & Co. (member elected by the Bengal Chamber of Commerce).
12. MR. N R. SARKAR of the Hindustan Co-operative Insurance Society, Limited (member elected by the Bengal National Chamber of Commerce).
13. MR. SHEO KISSEN BHATTER (member elected by the Indian Chamber of Commerce).
14. MR. ADAMJEE DAWOOD of Messrs. Adamjee Hajee Dawood & Co. (member elected by the Muslim Chamber of Commerce).
15. MR. MAHADEO LALL AGARWALA (representative of the Jute trade, nominated by the Government of Bihar).
16. MR. LALIT MOHAN DUTTA (representative nominated by the Government of Assam).

Eight persons representing agricultural interests, viz.—

17. COMMISSIONER OF THE CHITTAGONG DIVISION (nominated by the Government of Bengal).
18. MAHARAJA SRIS CHANDRA NANDY OF KASSIMBAZAR (nominated by the Bengal Government).
19. TAMIZUDDIN KHAN, M.L.C. (nominated by the Government of Bengal).
20. MR. RAJIBUDDIN TARAFDAR, M.L.C. (nominated by the Government of Bengal).
21. DR. NARESH CHANDRA SEN GUPTA, M.L.C. (nominated by the Government of Bengal).
22. MR. PRIYA NATH SEN (nominated by the Government of Bengal).
23. DIRECTOR OF AGRICULTURE, ASSAM (representative of Jute Growers, nominated by the Government of Assam).
24. MR. RAGHUBANS PRASHAD SINGH OF KURSELA (representative of Jute Growers, nominated by the Government of Bihar).

Madras

MR. D. G. MUNRO, B.Sc., Deputy Director of Agriculture and Officiating Principal, Agricultural College, Coimbatore, has been granted leave for six months and 28 days with effect from the 4th January 1937.

Consequent on the return of MR. T. J. HURLEY, M.R.C.V.S., D.V.S.M., Principal, Madras Veterinary College, from leave, the following postings of officers in the Madras Veterinary Service have been made :—

1. MR. K. KAILASAM AYYAR, G.B.V.C., Acting Principal, Madras Veterinary College, on relief by MR. HURLEY, to be Superintendent, Serum Institute, Madras.
2. MR. C. S. MURTI, G.B.V.C., Acting Superintendent, Serum Institute, on relief to be District Veterinary Officer, Rajahmundry.
3. MR. L. KUMARASWAMI PANTULU, District Veterinary Officer, Rajahmundry, to be District Veterinary Officer, Vizagapatam.
4. MR. M. PONNAYYA, District Veterinary Officer, Vizagapatam, to be District Veterinary Officer, Trichinopoly.
5. MR. R. SWAMINATHAN, District Veterinary Officer, Trichinopoly, to be District Veterinary Officer, Bellary ; and
6. MR. K. SESHAGIRI RAO, G.M.V.C., District Veterinary Officer, Bellary, to be District Veterinary Officer, Madanapalle.

Bombay

MR. G. P. PATHAK has been confirmed in the post of Cotton Superintendent, Surat, with effect from 25th July 1936, *vice* MR. C. S. PATEL, retired.

MR. G. P. PATIL, Acting Division Superintendent of Agriculture, Deccan Canals, has been appointed to officiate as Deputy Director of Agriculture, Gujarat, *vice* MR. B. S. PATEL, N.D.D., N.D.A., C.D.A.D., proceeded on leave.

MR. G. P. PATHAK, Cotton Superintendent, Surat, held charge of the post of Deputy Director of Agriculture, Gujarat, in addition to his own duties, from the date from which he took it over from MR. B. S. PATEL till relieved by MR. G. P. PATIL.

Consequent on the reversion of RAO BAHADUR V. A. TAMHANE, M.Ag., M.Sc., from Sind the following appointments have been made :—

1. RAO BAHADUR V. A. TAMHANE, M.Ag., M.Sc., to be Chief Investigator, Dry-farming Research Scheme, and
2. MR. N. V. KANITKAR to be Assistant Investigator, Dry-farming Research Scheme.

MR. Y. N. MARATHE, Deputy Director of Veterinary Services, Bombay Presidency, has been granted leave for three months and fifteen days with effect from the 4th January 1937.

MR. V. N. KULKARNI, Veterinary Inspector, Southern Range, has been appointed to act as Deputy Director of Veterinary Services, Bombay Presidency, *vice* MR. Y. N. MARATHE, proceeding on leave.

Bengal

MR. J. N. SIRKAR, M.S.A. (Japan), Deputy Director of Agriculture, Western Circle, has been granted leave on average pay for the period from 3rd December 1936 to 23rd December 1936.

MR. J. M. LAHIRI, M.R.C.V.S., has been appointed to be Vice-Principal in the Bengal Higher Veterinary Service, on probation, for two years, with effect from the 1st December 1936, or any subsequent date on which he may take over charge.

MR. KUMUD CHANDRA SEN, G.B.V.C., Lecturer, Bengal Veterinary College, has been allowed leave on average pay for the period from 5th January 1937 to 28th February 1937, both days inclusive.

MR. SATYA CHARAN MUKHARJI, Assistant Lecturer, Bengal Veterinary College, has been appointed to act as Lecturer of that College in addition to his own duties, during the absence, on leave, of Mr. KUMUD CHANDRA SEN, or until further orders.

United Provinces

MR. J. H. RITCHIE, M.A., B.Sc., I.A.S., Director of Agriculture, United Provinces, has been granted leave out of India on half average pay for a year in extension of the leave already granted to him.

MR. P. B. RICHARDS, A.R.C.S., F.E.S., I.A.S., Entomologist to Government, United Provinces, will continue to officiate as Director of Agriculture, United Provinces, *vice* MR. RITCHIE.

MR. H. N. SHARMA, B.A., Assistant Entomologist, will continue to officiate as Entomologist to Government, United Provinces, *vice* MR. RICHARDS.

Punjab

On the expiry of the leave granted to him, SARDAR SAHIB SARDAR KHARAK SINGH, M.A., I.A.S., Deputy Director of Agriculture, retired from service with effect from the 23rd November 1936.

On return from leave MR. LABH SINGH, L.Ag., B.Sc. (Agri.), resumed charge of the duties of Professor of Agriculture, Punjab Agricultural College, Lyallpur, on the 7th November 1936.

Consequent upon the appointment of MR. J. F. SHIRLAW, M.R.C.V.S., Professor of Pathology, Punjab Veterinary College, Lahore, as Officer-in-Charge of the Pathological Section at the Imperial Veterinary Research Institute, Muktesar, MR. KARAM ELLAHI, G.P.V.C., Professor of Parasitology at the College has been appointed to carry on the duties of the Professor of Pathology in addition to his own duties with effect from the 16th September 1936.

MR. MOHAMMAD SHARIF KHAN, B.A., Officiating Deputy Superintendent, Civil Veterinary Department, Ambala, has been appointed Officer-in-Charge of the duties of the post of Superintendent, Civil Veterinary Department, Ambala Division, Ambala, in addition to his own duties, with effect from the 12th June 1936 to 12th August 1936.

Burma

MR. R. WATSON, N.D.A., I.A.S., on relief by MR. J. W. GRANT, I.A.S., has been posted as Deputy Director of Agriculture, Southern Circle, in place of U BA MAUNG, B.A.S., Class II, proceeding on leave.

MR. J. W. GRANT, M.A., B.Sc., I.A.S., on return from leave has been reposted as Rice Research Officer, Burma, in place of MR. R. WATSON, I.A.S., transferred.

Central Provinces

RAI BAHADUR R. V. PILLAI, G.B.V.C., Deputy Director of Veterinary Services, Central Provinces, has been granted leave for eight months, with effect from the 10th December 1936.

MR. P. S. NAIR, G.B.V.C., Assistant Director of Veterinary Services, in charge of Laboratory, has been appointed to officiate as Deputy Director of Veterinary Services, Central Provinces, in the Central Provinces Veterinary Services, Class I (new scale).

North-West Frontier Province

LT.-COLONEL E. W. C. NOEL, C.I.E., D.S.O., Director of Agriculture and Allied Departments, North-West Frontier Province, has been granted leave *ex*-India, on average pay for four months with effect from the afternoon of the 20th October 1936.

MR. D. P. JOHNSTON, A.R.C.S.C.I., N.D.A., I.A.S., Assistant Director of Agriculture, Punjab, will officiate during the absence of LT.-COL. E. W. C. NOEL, on leave.

Obituary

KENNETH MCLEAN

We very much regret to announce the death of Mr. Kenneth McLean, Director of Agriculture, Bengal. Mr. McLean contracted a severe form of malaria apparently during the Christmas holidays and died at Dacca on the 14th January 1937. It is hoped to publish an account of his career in the next number of this journal.

RAO BAHADUR M. DESAI, D.AG. (BOM.)

A Grand Old Man of the Bombay Agricultural Department passed away on the 8th of September 1936 in the person of Rao Bahadur Bhimbhai M. Desai at the age of 67. He belonged to a land-holding Anavil-Desai Brahmin family of Gujarat which, during his father's life time, became considerably straitened in circumstances due to losses in cotton business. After passing the Matriculation examination, he entered the Baroda Arts College where Sir Thomas Middleton recognised his abilities. Mr. Mollison, who had just then arrived in India, took up the young Bhimbhai on Sir Thomas Middleton's recommendation and gave him a scholarship for three years at the College of Science in Poona which then had an agricultural course leading to a Diploma of the Bombay University which Rao Bahadur Bhimbhai secured in 1896. He then started work in the Department as a fieldman on the Surat Farm and later became a Superintendent of that farm. He was sent on duty at one time to re-organise the Hissar Farm in the Punjab. In 1900 and again in 1919 he was put on special famine duty in Gujarat. A great deal of Mr. Mollison's famous book on Indian Agriculture was based on Rao Bahadur Bhimbhai's notes. In 1903-04 he was again on special duty to develop a new cotton farm at Mirpurkhas. In Gujarat, he continued to work and was made Deputy Director in 1920. His greatest work in Gujarat was his organization of the seed-supply of long-staple cotton. In many other directions, however, he was very active and in 1928 during the heavy floods rendered special services to the afflicted public. He was also an excellent judge of cattle. From 1924 to 1929 he was a member of the Indian Central Cotton Committee. In 1929 he did his last job, as General Secretary of the Presidency Agricultural Show at Ahmedabad, which was a great success. He was awarded the title of Rao Saheb in 1923 and of Rao Bahadur in 1929, in which year he also retired. He continued to have a keen interest in the question of agricultural development right up to the time of his death. In figure he was tall, athletic and dignified right up to his old age. Although he suffered greatly both in his family and in his person from the slings and arrows of fortune, he never bowed his head and continued to the end a most courageous gentleman.

REVIEWS

Citrus Diseases and their Control. By Howard S. Fawcett. 2nd edition. Pp. xv+656, 187 figures. (New York and London : McGraw-Hill Book Company, Inc., 1936). **36s.**

A decade has elapsed since the first edition of this classical book was published in conjunction with Mr. H. A. Lee who, the present author states, "has graciously requested withdrawal from participation in this revised publication because of his transfer of interest to other problems". The increase in knowledge during this period has rendered necessary extensive revision throughout the book. The new edition, however, retains the ground plan of the original book. A new chapter has been added dealing with diseases due to deficiency or excess of inorganic constituents.

The book is divided into four parts of which the first is introductory, containing eight chapters (110 pages) on the history of investigation into citrus diseases, varieties and species of Citrus, classification of fungi, geographic distribution of citrus diseases, conditions affecting their development and severity, general principles of prevention and control, fungicides and cultural operations in relation to citrus diseases.

Part II, which comprises 115 pages, deals with the root and trunk diseases. In Chapter IX is given an account of the root diseases, and mention has been made of the mycorrhiza fungus which normally lives in symbiosis with the host protoplasm and becomes parasitic under certain conditions of unbalance such as the application of nitrate of soda to the soil. Chapter X discusses gum formation as a general phenomenon and gives a detailed account of brown-rot gummosis of citrus. Chapter XI deals with the diseases of trunk and main branches including, among others, such diseases as psorosis, probably of virus origin, and Diplodia gummosis.

Part III, comprising 147 pages, treats of the diseases of branches, twigs and leaves. Chapter XII deals with eruptive diseases and discusses at length citrus canker which, we are told, probably originated in India or Java and the specimens of which were collected near Dehra Dun as far back as 1827—1831. Another important disease dealt with in this chapter is leprosis reported from Northern India, the cause of which is still unknown. Chapter XIII gives in some detail an account of sooty mould, powdery mildew and other superficial diseases. Chapter XIV deals with leaf spots and Chapter XV with diseases causing death of entire parts such as anthracnose of twigs and leaves, "mal secco", citrus blast,

etc. Chapter XVI gives an account of abnormalities such as witches' broom, chlorosis, mottle-leaf, etc. This is followed by Chapter XVII on diseases due to deficiency or excess of inorganic constituents.

Part IV (215 pages) is occupied with fruit diseases. Chapter XVIII gives in some detail an account of fruit rots which are classified as soft rot, leathery rot and dry or firm rot. This is followed by Chapter XIX on internal non-parasitic maladies of the fruit. Chapter XX deals with external stains, spots and eruptions of the fruit. The final chapter contains an account of deterioration and decay of citrus fruits during all stages connected with picking, washing, packing storage and transport. The book closes with a bibliography of 42 pages (containing about 1,050 titles) as against 18 pages of the first edition and a good subject and author index.

The book is well illustrated with excellent figures and is free from errors (The word "santa" on page 178, line 39, should read "santra"). It is, indeed, the most up-to-date and complete work on the diseases of citrus and is sure of a hearty welcome from all those concerned with the health of citrus plants, especially from those research workers who are not fortunate enough to possess extensive library facilities. [B. N. U.]

Agricultural Marketing in Agra District. By H. L. Puxley (Calcutta, Bombay, Madras, London, New York, Toronto : Longmans, Green & Co., Ltd.) Price Rs. 2.

This study of conditions in the Agra district (United Provinces) endeavours to trace the movement of wheat from the Farm to the large assembling centres, first through the village *beopari* or dealer and thence to the town or city *artya* or wholesale merchant. Special reference is made to the local methods and costs of storing grain and the importance of grading has also been stressed. The effect of octroi duties, which the author states, are levied usually on bulk or some other arbitrary classification instead of value, and the present condition of rural communications, on the marketing of agricultural produce, is examined and discussed. [A. M. L.]

NEW BOOKS
On Agriculture and Allied Subjects

Laboratory Experiments in Physiological Chemistry. By Anderson, Prof. Arthur K. Med. 8vo. Pp. vii+224. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1936). *7s. 6d.* net.

Oxidation-Reduction Potentials in Bacteriology and Biochemistry. By L. F. Hewitt. (Issued by London County Council). Fourth edition. Sup. Roy. 8vo. Pp. 101. (London : P. S. King and Son, Ltd., 1936). *2s.*

A Text-book of Pharmacognosy. By Trease, George Edward. Second edition. Demy 8vo. Pp. xii+671. (London : Bailliere, Tindall and Cox, 1936.) 21*s.* net.

The Student's Manual of Microscopic Technique : with Instructions for Photomicrography. By Tobias, J. Carroll. Med. 8vo. Pp. xvii+210. (London : Chapman and Hall, Ltd., 1936). 10*s.* 6*d.* net.

Flora of Jamaica : containing Descriptions of the Flowering Plants known from the Island. By Fawcett, William, and Rendle, Alfred Barton. Vol. 7. Dicotyledons—Families Rubiaceae to Compositae. By the late Spencer Le Merchant Moore and A. B. Rendle. Demy 8vo. Pp. ix+303. [London : British Museum (Natural History), 1936]. 15*s.*

Birds of an Indian Garden. Fletcher, T. Bainbridge, and Inglis, C. M. Second edition, revised and enlarged. (Calcutta : Thacker, Spink and Co. ; London : W. Thacker and Co., 1936). 18*s.* net.

Growth Hormones in Plants. By Jensen, Boysen. Authorised English translation of "Die Wuchsstofftheorie und ihre Bedeutung fur die Analyse des Wachastums und der Wachstumsbewegungen der Pflanzen". Translated and revised by George S. Avery, Jr. and Paul R. Burkholder, with the collaboration of Harriet B. Creighton and Beatrice A. Scheer. (McGraw-Hill Publications in the Agricultural and Botanical Sciences). Med. 8vo. Pp. xiv+268. (New York and London : McGraw-Hill Book Co., Inc., 1936). 21*s.*

On the Floral Morphology of *Elettaria cardamomum* Maton (with special reference to the Interpretation of Floral Structure on the Evidence of Ontogeny and of Vascular Anatomy). By Thompson, John McLean. (University of Liverpool : Publications of the Hartley Botanical Laboratories, No. 14). F'cap. folio. Pp. 23. (Liverpool : University Press of Liverpool, 1936). 3*s.* 6*d.*

Regional Types of British Agriculture. By Fifteen Authors. Edited by Maxton, J. P. Demy 8vo. Pp. 318. (London : George Allen and Unwin, Ltd., 1936). 12*s.* 6*d.* net.

The Tropical Garden : its Design, Horticulture and Plant Materials. By Kuck, Loraine E., and Tongg, Richard C. Demy 8vo. Pp. xi+378+16 plates. (New York : The Macmillan Company, 1936). *12s. 6d.* net.

Fifty Years of Field Experiments at the Woburn Experimental Station. By Russell, Sir E. John, and Voelcker, J. A. With a Statistical Report by W. G. Cochran. (Rothamsted Monographs on Agricultural Science). Demy 8vo. Pp. xvi+392+4 plates. (London, New York and Toronto : Longmans, Green and Co., Ltd., 1936). 21*s*. net.

Diseases and Pests of the Rubber Tree. By Sharples, Arnold. Med. 8vo. Pp. xvii+480+24 plates. (London : Macmillan and Co., Ltd., 1936). 25*s*. net.

On Deficiency of A Vitamin and Visual Dysaptation. By Edmund, C. and Clemmesen, S. Roy. 8vo. Pp. 92. (London : Oxford University Press, 1936). 5*s*. net.

Food and the Principles of Dietetics. By Hutchinson, Robert, and Mottaram, V. H. Eighth edition. Demy 8vo. Pp. xxvii+634+3 plates. (London : Edward Arnold and Co., 1936). 21*s*. net.

The Comparative Anatomy of the Nervous System of Vertebrates, including Man. By Kappers, C. U. Ariens ; Huber, G. Carl, and Crosby, Elizabeth Caroline. Imp. 8vo. Vol. 1. Pp. xviii+864. Vol. 2. Pp. xii+865—1845. (New York : The Macmillan Co., 1936). 63*s*. net.

The Nutritive Value of Fruits, Vegetables and Nuts. By R. A. McCance, E. M. Widdowson and L. R. B. Shackleton. (Special Report Series, No. 213 of the Medical Research Council). Roy. 8vo. Pp. 107. (London : H. M. Stationery Office, 1936). 2*s*. net.

The Principles of Bacteriology and Immunity. By Topley, W. W. C., and Wilson, G. S. Second edition. Roy. 8vo. Pp. xv+1645. (London : Edward Arnold and Co., 1936). 50*s*. net.

Milk and Milk Products. By Clarence Henry Eckles ; Willes Barnes Combs and Harold Macy. Pp. 383, 6 × 9, illustrated (London : McGraw-Hill Publishing Co., Ltd.). 21*s*. net.

Botany. By J. Ben Hill, Lee O. Overholts and Henry W. Popp. Pp. 672, 9 × 6, illustrated. (London : McGraw-Hill Publishing Co., Ltd.). 24*s*. net.

Morphology of Vascular Plants : Lower Groups. By Arthur J. Eames. Pp. 433, 9 × 6, illustrated. (London : McGraw-Hill Publishing Co., Ltd.). 24*s*. net.

Hardy Fruit Growing. By Sir Frederick Keeble and A. N. Rawes. Illustrated. (London : Macmillan and Co., Ltd.). 16*s*. net.

Rural Welfare in India. By C. F. Strickland. Pp. 54. (London, Bombay, Calcutta, Madras : Oxford University Press, 1936). Price As. 8.

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II. Obtainable from the Imperial Bureau of Animal Health, Veterinary Research Laboratory, New Haw, Weybridge, Surrey

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Agriculture & Live-stock in India

Vol. VII, Part III, May 1937

EDITORIAL

REPORT OF THE BRITISH COMMONWEALTH SCIENTIFIC CONFERENCE, LONDON, SEPTEMBER, 1936

THIS Report has recently been published as a Command Paper (Cmd. 5341, obtainable from His Majesty's Stationery Office, price 1*s.* 3*d.* nett). The title might mislead those not acquainted with the genesis of the Conference, for it was a conference of the administrative heads of Scientific Departments rather than a conference of scientists, and the agenda was more concerned with arrangements for co-operation in scientific research on specific economic problems than with the discussion of scientific matters. Nevertheless, much useful work was done and the Conference is another landmark in intra-Imperial economic co-operation.

The Report deals with many matters which are familiar to agricultural research workers in India. One of the most important results of the IMPERIAL AGRICULTURAL CONFERENCE OF 1927 was the establishment of eight Imperial Agricultural Bureaux for the collation and dissemination of information regarding agricultural and veterinary research. Many research workers in India have acknowledged their indebtedness to this organisation and expressed their appreciation of the abstracts issued by various Bureaux of the translations of inaccessible articles which have been made available to them and of the special bibliographies on important subjects. Even with the aid of the modern abstracting journals it is difficult to keep touch with the progress of modern scientific literature and the full summaries and technical communications which the Bureaux issue have done much to lighten the drudgery of searching literature. The other side of the shield is the economy in the time of investigators which results from a lessening of the amount of unintentional and unnecessary duplication of experimental work.

The work of these Bureaux was very favourably commented on by the Committee on Imperial Economic Co-operation, better known as the Skelton Committee, which met in 1933 as a result of one of the recommendations of the Imperial Economic Conference of 1932. On the Skelton Committee India was represented by Sir Atul Chatterjee and Sir Padamji Ginwala. That Committee found the Executive Council of the Imperial Agricultural Bureaux to be an entirely suitable organisation for the control of co-operatively-financed Empire research schemes. As a result of their recommendations, the control of the Imperial Institute of Mycology and the Imperial Institute of Entomology was transferred to the Executive Council which also undertook the administration of certain other schemes of Empire importance which were initiated by the Empire Marketing Board and subsequently co-operatively financed.

The main task of the Conference of 1936 was to review the work of the Executive Council of the Imperial Agricultural Bureaux since 1933 and to review the Bureau system since its inception and to make proposals to various Governments of the Empire for the future. So far as the Bureaux were concerned, it may be said at once that the Conference found them in every way satisfactory and that it was able to make a number of suggestions for development and improvement in detail so that their work may be even more widely useful. The work of the Institutes of Mycology and Entomology and of the Farnham House Parasite Laboratory also came in for appreciative reference, and recommendations for provision of funds for the next five years were also made. Of special interest to India is the recommendation that two new bureaux should be established, *viz.*, an Imperial Bureau of Forestry and an Imperial Bureau of Dairying. That recommendation has been commended to the Governments of the Empire for consideration and it must suffice to say here that the Conference was fully convinced of their need and utility.

Several subjects of general interest were discussed of which may be mentioned research on the transport and storage of foodstuffs, on the control of insect infestation of stored products and on the properties and utilisation of wool. The Conference passed the following resolutions on matters arising from the Imperial Mycological Conference, 1934, and, the Imperial Entomological Conference, 1935 :—

> "The Conference notes the valuable progress which has been made in securing agreement within the Commonwealth to the model form of health certificate to accompany exports of living plants, recommended by the Imperial Mycological Conference of 1934, and in view of the advantages to be attached to the adoption of the model form throughout the Commonwealth, recommends that those governments which have so far been unable to accept it completely, or which have not yet intimated their views, might be invited to consider, or reconsider, the possibility of adopting it as a step in the right direction ;
>
> "that the Conference hopes that in the light of experience of its use, the certificate might be reviewed at a later date with a view, if necessary and practicable, to improving its value ; and

"that the Conference stresses the importance of ensuring that the inspection to which the certificate relates is really effective".

"The Conference directs the attention of National Research Councils and similar bodies in the Commonwealth to the need for fundamental research into methods for the biological standardisation of fungicides and insecticides, and is of the opinion that it would be of material assistance to those already engaged on the work, if the Executive Council would consider the possibility of collecting programmes of work, preliminary results and reports and of circulating them to workers engaged upon such studies. The Conference also suggests that inter-communication might be facilitated if each country set up a suitable organization to consider these questions and bring together information available within its own country".

An important discussion also took place on collaboration in scientific research. Of particular interest to agricultural officers and research workers are the discussions on proposals for collaboration in the collection and maintenance of plant materials for crop improvement and paragraphs 130-133 of the Report will bear repetition in full :—

The Bureaux already do what they can in aiding research workers in obtaining new plant material they require, but this does not fulfil the needs of agricultural scientific departments.

Two questions arise, *viz.*,—

(*i*) the necessity of sending exploratory expeditions to obtain new varieties or new species of plants suitable either for introduction into particular countries or for purposes of plant breeding ;

(*ii*) the maintenance of stocks of varieties and species when procured.

The object in both the proposals before the Conference was to reduce expense and to facilitate scientific work by closer collaboration between countries. The Conference was of the opinion, as regards the first of these questions, that advantages would result if, whenever an exploratory expedition was contemplated or planned by any country, full particulars were sent to the Executive Council so that other countries could be informed and given an opportunity of sharing therein, if they so wished.

As regards the second question, the Conference was of opinion that it was desirable for every plant breeding station to prepare detailed descriptive lists of the material it is maintaining and to send such lists to the appropriate bureau. There they would be consolidated and possibly circulated. The possession by the bureau of such lists would enable it more efficiently to discharge its function of facilitating the interchange of plant breeding material among workers in the Commonwealth. The importance was stressed of the maintenance by plant breeding institutes of stocks of the original material from which new strains had been developed.

The Conference agreed that these two subjects should be remitted to the Executive Council for further consideration.

A proposal for an investigation into control of damage by termites was also considered and the Conference passed the following resolution :—

"The Conference, having considered the memorandum, prepared on behalf of the Colonial Delegation, into Control of Damage by Termites, recognizes

the vital importance of this problem to many Governments of the Commonwealth, and while it finds itself unable to recommend the establishment of a special organization, co-operatively financed, on the lines proposed,

(*a*) commends to governments the desirability of the interchange of information on all aspects of the problem ;

(*b*) suggests that, as a measure of mutual assistance, each interested government should give consideration to the possibility of compiling detailed summaries of the information available from its own internal sources with a view, ultimately, to making them available to other governments in the Commonwealth through the Executive Council and, if possible, to co-operation between governments in the preparation of a complete monograph of the subject ;

(*c*) recommends that the Executive Council should consider the preparation and distribution of an Index of heads under which information is desired, to cover and amplify the aspects of the problem summarised in the memorandum presented by the Colonial Delegation, and to serve as a basis for the compilation of information in individual countries.

A valuable appendix to the Report is the historical summary of the work of the Executive Council of the Imperial Agricultural Bureaux by Sir David Chadwick, Secretary to the Council (and Secretary to the Imperial Economic Committee), who is still well-remembered in India as Director of Agriculture, Madras, as the first Indian Trade Commissioner in London and latterly as Commerce Secretary to the Government of India.

The late Mr. Kenneth McLean, B.Sc., I.A.S.

OBITUARY

KENNETH McLEAN, B.Sc., I.A.S.

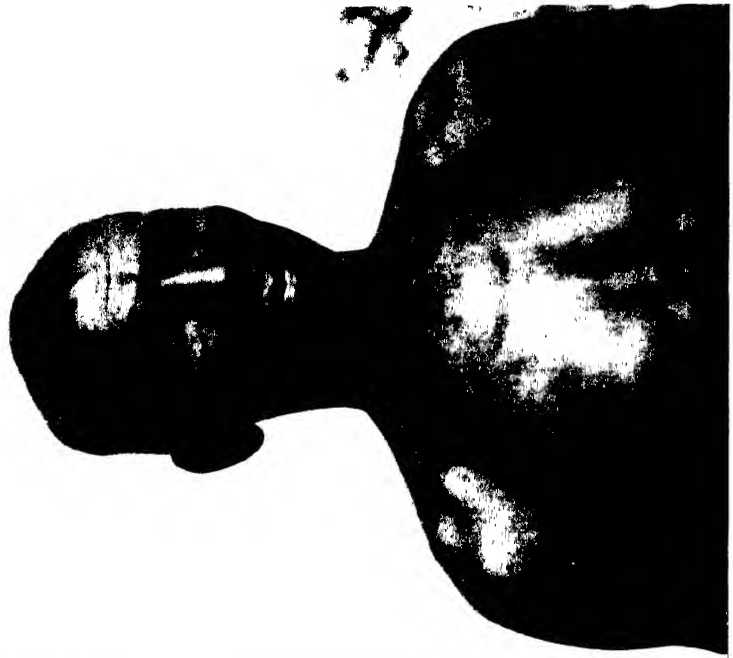
By the untimely death of Mr. Kenneth McLean, the Indian Agricultural Service has suffered a very great loss which can be ill afforded, especially now when so few members are left. To India in general, and Bengal in particular, he had proved his sterling worth both as an official and as a man; and in the province where most of his service was spent, his sound commonsense, keen ability and wide and varied deep knowledge of agricultural practices, will be sadly missed.

Born at Golspie, Sutherland, on 30th July, 1890, he was educated at Edinburgh Academy, and afterwards at Edinburgh University. There he took his B.Sc. Degree in Agriculture in 1912 and then spent a year in Canada in the Forestry Department. Joining the Indian Agricultural Service in October, 1914, he was for some three months under training at Pusa, and was then posted to Dacca as a Deputy Director of Agriculture in February, 1915. From October, 1916, till the beginning of 1919 he was on military duty, serving with a Gurkha Battalion, chiefly on the Frontier. On returning to civil duty, he rejoined the post of Deputy Director of Agriculture, Eastern Circle, with headquarters at Dacca.

As Deputy Director of Agriculture he did much to get the first results of research work carried out at Dacca into the hands of the cultivators and, in addition, he introduced the cultivation of English vegetables as early as 1915. This has become an important crop in the last few years, particularly near about Calcutta and Dacca. In December, 1922, he took over the office of the Fibre Expert and, when the special post of Assistant Director of Agriculture was made in 1925, he was given charge of the Fibre Expert's Section also. In this post he showed high administrative qualities and proved of very great assistance to the Director. On the departure of Dr. Hector, in September, 1933, he was appointed to officiate as the Director of Agriculture, Bengal, being made substantive in October, 1935. Thus, for nearly 3½ years up to the day of his death, he filled the position of the Director. During this period he put out a number of schemes of very great value to the province. These showed his very great knowledge of the agricultural needs of the various parts of the province and were models of simple effectiveness. His great ability in carrying on the administration of the Department was also clearly proved.

As an officer he was extremely popular with the members of the Department and the general public; and the expressions made about him both by officials and non-officials since his death have shown that he was equally well liked outside his official capacity.

For several years before his death he had been suffering from severe rheumatism and neuritis, and though at times he must have had great pain, he was never failing in courtesy and sympathy when dealing with others. Such a loss of an officer who was at the height of his powers is a very great tragedy. The high standard he set both as a man and as an official, will long be remembered by those who knew him. [M. C.]



A typical Hindu cultivator of Bengal

A typical Mohammedan cultivator of Bengal

ORIGINAL ARTICLES

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

I. THE BENGAL CULTIVATOR

BY

* K. McLEAN, B.Sc., I.A.S.

(late Director of Agriculture, Bengal)

It is commonly supposed that the Bengal cultivator lives a life of idleness for six months or more in the year. This may be so where the land is single-cropped, but a large area in Bengal is cropped twice or even three times in the year. In Eastern Bengal particularly, where the average holding is less than two acres, the cultivator must lead a strenuous life to gain sufficient from the land to maintain his family. In Western Bengal there are large holdings on which transplanted *aman* (late or winter) paddy is the only crop. The owners are seldom cultivators; they employ labourers who are usually paid in kind. The same applies in the single-cropped *aman* paddy land in the Sunderbans. In the *Bhil* tracts, a series of depressions which are flooded except for some three months in the year, the cultivator has a strenuous period in the dry season, harvesting his deep-water *aman* paddy and preparing the land rapidly for the next crop so as to get it sufficiently advanced to stand up to the flood water when it comes. For the remaining nine months of the year he is not idle, as fishing occupies his time, and he usually has a small area of land round the homestead where he grows vegetables and condiments.

Where the land is cropped twice or three times, the cultivator has little time for leisure. Ploughings for the *aus* (early or autumn paddy) crop commence in February or March as soon as the *rabi* crop is off the ground. The land is ploughed five or six times and the clods broken down by the 'ladder'—the Bengal equivalent of the *hanga*—or beam, or by hand with a mallet. The crop, jute or *aus* paddy, is sown after the first suitable showers. After germination a bamboo rake may be run through the crop to loosen the soil and thin out the stand; but usually mulching, weeding and thinning is done by hand with a *khurpi*. *Aus* paddy is generally weeded twice, but jute receives two weedings and three thinnings. The last thinning is done when the plants are five to six feet high, and the

*Mr. Kenneth McLean passed away on the 14th January 1937. A short account of his life and work is given in another place in this issue.

plants thinned out are steeped and retted for fibre. August is the busy month of harvesting, and as it is a particularly wet month, the conditions are very trying. The paddy is cut and carried to the homestead, where it is threshed by bullocks and advantage has to be taken of the short periods of sunshine in drying the grain. This in itself is laborious as the grain has to be taken to shelter in the event of rain and exposed again when the sun shines. Jute matures at the same time as *aus* paddy. It is cut close to the ground with a sickle, left in bundles for a short time for the leaves to shed, and then carried to the retting pool. The cultivator, standing in water up to his waist, lays the bundles in series and one above the other until the heap reaches water level when weights are placed on the top to keep it submerged. Retting is completed in about twenty days and, from the sixteenth day onwards, the heap is examined to see how far retting has advanced. Stripping off the fibre and washing means many days' labour in waist-deep water. Drying the fibre on bamboo supports is less arduous, but requires careful watching and manipulation of the fibre to ensure that the drying is even throughout.

Having harvested his *aus* paddy, which he usually uses for family consumption, and his jute which he sells, the cultivator turns to his *aman* paddy transplantation. Whilst jute and *aus* paddy are reaching maturity, he has prepared his *aman* paddy seed-beds ; and, as soon as the crops are off the land, the seedlings are ready for transplanting. Puddling and transplanting in knee-deep mud occupies the cultivator for several days, and tired men and bullocks are glad to see the work completed. If the rainfall is sufficient, weeding is unnecessary, but there are many years in which weeds have to be removed. Having finished transplanting, the cultivator has time to think of marketing his jute. He carries it to market in his boat if communications are convenient, or on his head across the country if they are not. For a month or so work eases off. In November comes the *aman* paddy harvest, which is less exacting than the *aus* paddy harvest as the weather is generally fine. The land has now to be rapidly prepared for *rabi* sowings before moisture is lost. Mustard, pulses and occasionally barley or wheat are the usual *rabi* crops grown. These require a certain amount of weeding and mulching whilst they are on the ground ; and immediately they are harvested the cultivator starts the yearly round again, preparing the land for his *aus* crop. Where the land is cropped three times *rabi* cultivation is not intensive ; where it is double-cropped potatoes, chillies, tobacco, etc., are grown intensively, and watered by hand.

The cultivator has a long day. Apart from work in the fields, he has to see to the feed of his cattle and repairs to his houses, etc. ; and who can blame him if one day in the week he repairs to the local market in the afternoon, whether he has a purchase or sale to make or not ? He smokes some extra pipes and hears the news of the outside world. Dawn finds the cultivator up and about on the way

to the field. His breakfast consisting of re-heated boiled rice is brought to him in the field and he carries on till midday when he returns to the homestead for the big meal of the day. This consists of rice and curry which may be made of vegetables only or include fish according to the season. A *dal-puree* usually accompanies the curry. An hour's siesta settles down the meal and the fields claim attention again up to twilight when he returns to the homestead. The cattle are fed and settled for the night, and a wash and a smoke precede the evening meal which again consists of rice and curry. The cultivator is a good trencherman and a consumption by an adult of 2 lbs. of rice a day is not exceptional. Nine o'clock finds the household abed and asleep.

The accommodation the cultivator provides for his family depends on his prosperity. Unlike Upper India, there is no clustering of houses in villages except in parts of West Bengal and in the *Bhil* areas, where the homesteads are perched in a long line on artificially raised embankments. Elsewhere the cultivator lives in the midst of his land as the crofter does in Scotland. Religion and tradition demand several residential houses. There is the *baithakhana* where guests are received, the main dwelling house occupied by parents and young children, two or more sleeping houses for adult members of the family, a kitchen house and a cattle-shed. In Eastern Bengal the houses are erected on a mud plinth, wooden posts supporting a corrugated iron roof while the walls are made of matting. Owing to the pressure on the land, the corrugated iron roof has supplanted thatch. In Western Bengal, mud walls are common, surmounted by a thatched or a *kutcha* tiled roof. The Bengal cultivator does not appreciate Western furniture: he requires neither tables nor chairs. He may have a wooden *chowki* raised above the damp floor to sleep on, and may indulge in a mosquito net, but such sybarites are few. His furniture consists of necessities in the shape of cooking utensils and storage vessels for grain and household supplies. A stout box preserves the gala-day clothes which are produced at the Id or Hindu festival according to his religion. His working dress is limited and inexpensive—a *lungi* or loin cloth and a yard of calico which serves as a head protector when the sun is hot, a towel to mop his brow, and a receptacle for market produce as occasion demands. He has little time for amusements, but is an enthusiastic fisherman. His methods might not appeal to Isaac Waltons : all sorts of devices are brought into play—baited hooks, spears, nets and traps ; and he is just as enthusiastic over the catch as any angler. Bands of strolling players visit the countryside occasionally and are welcomed and criticised, and compared with local talent. In some districts, Government cinema parties exhibit instructional films interspersed with films in lighter vein, and these have proved a great attraction. The magic lantern is no longer magic, and soon even the silent film will be scorned.

The cultivator in Bengal is not addicted to intoxicants. On special occasions coconut water is used as a sweet and harmless beverage, and tea is rapidly becoming popular. For a stimulant with more " kick " in it he will now and then take

ganja. Perhaps amongst stimulants of the pernicious kind may be classed litigation in which he is all too prone to indulge. The Mussulman when in funds likes to give himself and his folks a treat, buying "hilsa" fish or mangoes even if they are expensive.

The Bengali cultivator is an indulgent parent and although often illiterate himself makes it his first endeavour to send his son to school. Pressure of work on the holding may often interfere with regularity of attendance, thus breaking the continuity of the schooling. There is also the other danger—never absent from any agricultural country—of the school-trained boy losing touch with the land.

Such in brief is the life of this hard-working and lovable cultivator.

THE TRIANGULAR PROBLEM OF NUTRITION IN INDIA*

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In a leading article entitled "The real problem in India", which appeared in the *Indian Medical Gazette* for May 1931, the following statement is to be found :—

"A problem in India which should be faced immediately, and will certainly have to be faced in the very near future, is that of balance of population and food supply. Until comparatively recent times this balance has been maintained by war, disease and sudden famine. By the maintenance of an efficient army war has been abolished, by irrigation and civil organisation famines have been reduced, whilst medical research and its application are now beginning to have a serious effect on the disease incidence and mortality rates throughout the length and breadth of the peninsula".

When that article was written fears were expressed that the position might be aggravated by a large increase in the human population, and as we now know that prognosis was a correct one, for the last decennial census showed an increase in human population from 320 millions to 350 millions.

The appearance of this article aroused considerable discussion at the time and some further comments appeared in the March 1932 number of the same journal, from which the following is culled :—

"Under the British rule it has been possible to increase the productivity of India to such an extent that 350 millions of people are able to live under better conditions than 200 millions used to do. It is within the bounds of possibility that even so many as the present 350 millions might live in a modest degree of economic well-being if production were increased and waste eliminated : but is there anyone so optimistic as to claim that 700 millions could gain a reasonable livelihood ?"

It is probable that such optimists do exist ; some may even be present at this meeting, and no doubt they have been encouraged in their optimism since Mr. Bruce, the Australian Premier, at a meeting of the Assembly of the League of

*Paper read at the Indian Science Congress, Hyderabad, 1937.

Nations in September 1935 made his now famous remark that agriculture should be married to public health in the interests of the latter, and that the consumption of protective foods should be increased as a remedy for both malnutrition and the agricultural crisis.

The object of this paper, however, is to show that, whatever the conditions may be in other countries, the problem in India is not so simple as Mr. Bruce's remarks imply. To continue the metaphor, agriculture in India is already married to animal husbandry, but it is only too apparent that this alliance has not been productive of any outstanding progeny up to the present, and it is to be feared that the introduction of a third party may aggravate rather than alleviate the position, unless this meeting is able to suggest ways and means by which both the consuming members of this triangular alliance can be satisfied.

The fact is that India differs from most other countries in that she has an enormous live-stock population competing with her human population for the existing food supplies, and, owing to social customs, she is not able to convert as much of her live-stock population into food for her human population as other countries are able to do. Moreover, for very much the same reasons as those given in the opening remarks for the increase in the human population, a gradual rise may now be expected in the animal population of this country; which is already greatly in excess of requirements and is likely to remain so, until some means are found of disposing of those animals which are not economic producers. Animal husbandry experts in India are, therefore, faced with the same special problem as that described at the beginning of this paper for public health officials, and in addition they have to consider how much they can contribute to the improvement of conditions for the human race.

The latest available census figures show that India, with an area of 1,800,000 square miles and a population of 352 million people, contains 300 million animals, excluding pigs and poultry, and of that number approximately 220 millions are to be found in British India and the remainder in Indian States. The number of cattle and buffaloes alone in British India is 154 millions and Indian States contain 47 millions while there are 26 million sheep and 36 million goats in British India, and 19 million sheep and 13 million goats in Indian States.

At a rough estimate we have about 300 million people living in the villages of India, *i.e.*, living on the land. The total area by survey is approximately 670 million acres in British India and 143 million acres in Indian States, making a total of 813 million acres or less than 3 acres per head of the agricultural population. The net area annually cultivated is approximately 300 million acres; or allowing 60 million acres for current fallow, a total cultivable area of 360 million acres. Much of the land is double cropped and the gross cropped area, apart from fallows, is about 340 million acres annually. Even if we include the very problematical figure for all cultivated waste, which is about 170 million acres, we still

get a total of only some 530 million acres or less than 2 acres per head of the village population. Of the total area cultivated approximately 270 million acres are placed under food crops annually and about 54 million acres under non-food crops. The area under food crops, however, includes such crops as rice and wheat, which in some districts are definitely grown as cash crops for sale. Of the area under non-food crops about 10 million acres only of special fodder crops are grown for the feeding of cattle, and animals obtain the remainder of their requirements from the straw and other residues of the crops grown for human consumption and by grazing in forest reserves, village grazing grounds, waste lands, etc.

In a recent survey of the live-stock industries of this country it was shown that the value of cattle labour does not equal that of dairy products, but in the minds of the vast majority of the ryots of India there is no doubt which of these two branches of the live-stock industry occupies the foremost place, and in considering this aspect of the fodder question we need to remember that, not only are cattle used as the main source of labour both for cultivation, irrigation and road transport in India, but, in addition, an enormous amount of transport work is also performed by ponies, donkeys, mules, camels, elephants in a few areas, and even by sheep and goats in some of the hilly tracts of India, and all these animals have to be fed.

The production of suitable animals, particularly oxen, for use as beasts of burden, is therefore of paramount importance in the economic life of India, and as the country is so large and composed of such varying conditions, one of the greatest difficulties confronting animal husbandry experts is to determine the best advice to give breeders in regard to providing suitable fodder for their young stock, which must be well fed if they are to be a paying proposition when mature, whether they are required for work, milk production or other purposes. While the advocates of mixed farming stress the well-known advantages of this system and the necessity for setting aside a certain area for the production of fodder crops, the economist knows that in many areas the yield of crops is so low that, with traditional methods of cultivation, the available land will yield only a bare sufficiency for the family, with possibly a little over for a pair or two of working bullocks and perhaps a cow in milk. As already explained the main fodder of these essential animals will be the residue from the human foodstuffs, so that there is, therefore, literally nothing left for the young stock and other non-producing animals, apart from what they can find for themselves. Those villages which are in the vicinity of forests open to grazing have a great advantage in this matter and even the dry pastoral areas of India, devoid as they appear to be for most of the year of any suitable grazing, rear better stock than the wet arable areas. One matter requiring urgent investigation is whether those forest areas, which are not capable of producing good timber, would be more profitably utilized than they are at present in providing land for the breeding and grazing of young stock. In the case of villages too far remote from grazing areas for these to be of any value to them, and in which the

struggle for existence is too intense to make mixed farming a practical proposition, the only solution appears to be to encourage the ryots to introduce some method of breeding control for their animals, and rely for their working animals on the internal trade, which is carried on through the agency either of drovers or fairs, the latter of which are spread like a network throughout India and deserve more attention from those interested in live-stock improvement.

Apart from what might be done to improve the egg-producing capacity of Indian poultry, it is only through milk and its products that the live-stock industry of India can make any direct significant contribution to the food supply of the human population of the country, although there are many other ways in which this industry might be used to improve the economic condition of the ryot, if it were better developed. In a recent survey it was estimated that a milk consumption of 10 oz. only per day per person could be taken for the entire population, including that which is consumed in the form of ghee, butter and other milk products. This was corroborated independently during a careful village survey carried out by Major-General Sir John Megaw, late Director-General, Indian Medical Service, who put the equivalent at 10·8 oz. of milk *per diem*. In other countries the consumption of dairy products is far higher than this, and in a country where the diet is mainly vegetarian, in order to obtain a satisfactory development of youth and for the maintenance of human health generally, the consumption of dairy products should be at least 2 or 3 times as much as it is at present in India.

The greatest limiting factor to an increased consumption of milk in this country is probably the small amount of this article produced by the average cow, but in this connection it should be noted that recent experimental work has shown that indigenous Indian cows, and to a less extent buffaloes, possess latent milking qualities which respond markedly and rapidly to proper feeding and management. One of the best examples of increased production under improved conditions is that of a pure-bred Sahiwal herd, maintained at one of the Military Dairy Farms in North India, which in less than 20 years, has shown an increase in its overall milk yield from 5·5 lbs. to 17 lbs. *per diem*. In this herd daily average yields as high as 27 lbs. have been recorded and one cow in 1931 produced 8,829 lbs. in a year's lactation. Moreover, the average butter-fat content of the milk produced by this herd is 4·6 per cent. These figures may be compared with the results recorded for the same year amongst English dairy Shorthorns, of which for the whole of England only 72 gave a yield of 9,000 lbs. or over, with a butter-fat content of only 3·7 per cent. In England it is now generally accepted that an average annual yield of 7,000 lbs. of milk is as much as it is sound to aim at in commercial dairying. The best Indian cows, therefore, already compare very favourably with the average English dairy cattle, while the possibilities of further improving them by selective breeding still remain.

The above is an attempt to summarise the present position in rural India in regard to her crops and their consumers, both human and animal, and problems

arising out of them. Of the live-stock population, it may be said that the main problem is to raise the productivity of the individual animal by efficient measures of disease control, the application of scientific principles to all breeding operations, and the introduction of improved methods of feeding, and so either increase the total output of the existing population, or, conversely, provide the present output with a smaller number of animals.

The subject of animal nutrition, which is the only one of the three above-mentioned sciences, that can be dealt with in any detail in this paper, has not yet received the amount of attention it requires in this country, but a good deal of preliminary investigational work has already been carried out by the Physiological Chemist's Section attached to the Imperial Institute of Animal Husbandry and Dairying at Bangalore, and at the laboratories attached to the Agricultural Colleges at Lyallpur and Coimbatore and more recently at Dacca. The main object of the work done in these places has been to determine the values of different foodstuffs meant for the use of cattle, notably from the protein standpoint, and data have been obtained showing the digestible nutrients in various kinds of fodders.

To give a few details, Indian coarse fodders have been the subject of intensive study, because these form the bulk of the ration and malnutrition almost invariably arises from deficiencies in these roughages. Numerous samples from various parts of the country have been examined as to their composition and digestibility and a nutritive value ranging from 14 to 60 S. E. (starch equivalent) per 100 lbs. of dry matter has been noted. The protein content varies from 1·9 per cent to 18 per cent which is attributable to (1) the stage of maturity, (2) soil conditions, and (3) characteristics of the species. It has been observed that with advancing maturity, the amount of digestible protein and the S. E. value decreases steadily and these facts are very significant from the practical standpoint. Maintenance experiments carried out in several parts of the country have shown that most of the straws are not sufficiently nutritious in the absence of cakes to keep animals in good condition, whereas some of the Punjab hays are by themselves maintenance rations for bullocks. Physiological studies carried out at Bangalore have shown that rice straw may induce diuresis in cattle; also that the nitrogen balance may be adversely affected by the production of aromatic acids and phenols and that the acid-base balance of the animal system depends upon the nature of the food. Investigations in the preparation of silage and determination of its nutritive value have been carried out at Bangalore and Lyallpur. Indian pasture grasses have also received some attention at Coimbatore and elsewhere and experiments have been started to determine the progressive changes in food value during maturing. A study has been made at Dacca in the use of water-hyacinth as a cattle food and the question of mineral requirements is receiving wide attention. Much of the work done has been of the greatest importance and has provided us with basic knowledge about the Indian fodders. In particular it has shown that with the fodder in common use in many parts of the country, the available diet is inadequate

to maintain the animals in good health and this chronic state of malnutrition has undoubtedly contributed largely to the degeneracy, which is to be observed in India on such a wide scale. A recent survey of the problem of malnutrition carried out at the Imperial Veterinary Research Institute, Muktesar, has shown that this degeneracy is not confined to a general physical deterioration of the stock : the productive power has been affected, breeding difficulties have become more common, and susceptibility to certain classes of disease has been increased.

To give a few illustrations on the above point, mineral deficiency has given rise to pica and osteomalacia in Madras and Hyderabad and the stunted growth of animals in Berar has been ascribed to the same cause. This is probably also true in parts of Bengal, Bihar and Assam. Milk yield in most of these areas is low, mortality is high and sterility is common. The disease known as "blindness in calves", which is usually associated with a non-specific form of abortion in cattle has been shown to be due to malnutrition. This was at first thought to be confined to Sind and Baluchistan, but good results have been claimed in the prevention of abortion in several places from the judicious use of mineral additions to the ordinary ration of dairy animals. It will thus be seen that the problem of malnutrition is an all-India one, but it may be found necessary to tackle this subject regionally because the type of malnutrition may not be the same in every part of the country.

The types of feeding stuffs available for cattle may be divided into two broad groups, namely coarse fodder or roughages and concentrates. The first group includes the grasses, legumes and straws, of which the first two may be fed either in a green or dry condition, or as silage. These roughages are characterised chemically by a relatively high percentage of fibre and the proportion of crude fat is small. Except in the case of the legumes, the amount of protein is low.

Regarding the distribution of the different types of straws in India, it may be observed that rice straw is the main fodder in Bengal, Assam, Madras, parts of Bihar and Bombay Presidency ; *jowar* is fed to cattle in most parts of India ; wheat and oat straw in the United Provinces, Punjab and in parts of the Central Provinces, and *ragi* straw in Madras, Mysore, Central Provinces and Bombay Presidency.

Grazing in varying quantity and quality is, of course, available throughout India, but little work has so far been done to improve natural Indian pastures and determine their feeding value, although the work on Punjab hays, already referred to, is of great significance in this connection. Speaking generally, India is poor in good pasture plants, but in special areas Guinea grass, Napier grass, Rhodes grass, etc., are grown in limited amounts, and amongst the legumes we have such good varieties as lucerne, berseem, clover, etc., the increased cultivation of which should be very profitable.

Among the concentrates, most of the cereal grains, such as rice, wheat, oats, barley, maize, etc., are primarily raised either for human consumption or for sale, but bran and other by-products find their way into the animal dietary. Some of the leguminous grains like peas and beans, and the millets may also be used as cattle food. The oil-seeds, such as cotton seed, linseed, rape, groundnut, etc., are commonly used for cattle rationing, specially as cakes after extraction of the oil, and are extremely valuable as a source of protein and crude fat.

A review of our available foodstuffs would be incomplete if we did not consider the effect on the fodder of the season of the year in which it is grown, and also the variability of the quality of the same fodder grown in different parts of the country. It has been observed that the nutritive value of a fodder varies considerably according to the place where it has been grown. This is of common knowledge in the case of grasses. In the case of cakes sold in the markets, there may also be a big variation in the food values, so that any system of proper rationing must take note of this variation.

Although in some periods of the year there is an abundance of green fodder in many parts of the country, most of this surplus fodder is lost and during the dry months there is hardly enough for animals to live on. As the vast majority of animals in India receive no supplement whatever to their grazing, this, of course, is a most serious matter for them. It is therefore of the utmost importance to devise means of suitably conserving the excess green fodder for use during the dry months. Two methods, *viz.*, making of silage and hay, are in common use though it cannot be said that silage making has yet become popular among the cultivators. For conserving green pasture, ensilage is one of the best methods, but one of its drawbacks is that the material is not transportable, whereas hay can be transported to long distances. Hay making as practised in India usually results in considerable loss in feeding value, but it is the only method by which any considerable amount of fodder is conserved at present in this country. The technical side of hay making should therefore be studied, so that the maximum amount of nutritive value of the original green material may be conserved.

Although the work which has so far been done has given us an insight into the difficult problem of animal nutrition in this country, the experiments have been more or less in the nature of preliminary trials and investigations of a more comprehensive nature are now needed for the study of the problem of animal nutrition in relation to maintenance of health, normal growth and increased productive capacity of our animals. One of the most important subjects for investigation is the preparation of suitable dietary standards for milch animals, working cattle and young stock, so that cheap balanced rations compiled from the foodstuffs ordinarily obtainable in different parts of the country can be made available. In order to carry out this programme, the analysis of a large number of foodstuffs and specimens from typical grazing areas will have to be done and long period feeding and

digestibility tests undertaken. Food in relation to wool production in the case of sheep, milk production in the case of cattle and goats, and reproduction in the case of all animals will have to be more intensively studied. The influence of diet on the susceptibility of animals to disease is now receiving a great deal of attention in other countries and should be studied under Indian conditions. In particular the mineral and vitamin requirements of Indian animals have to be considered and large-scale experiments will have to be undertaken to determine the amount required of these important and essential ingredients.

In conclusion we wish to emphasize that to solve this complex problem of nutrition in India a very comprehensive view of the position must be taken and in the words of Sir Robert McCarrison it must be realized that the problems of animal husbandry are also the problems of human husbandry.

We have shown that in India it is only through the cow and her products, and to a minor extent through poultry, that the products of the soil can be directly converted into the protective foods that are in such large defect in Indian diets, but at the same time proper provision must be made for feeding the working bullock and the many other animals used for transport purposes, for at present the general low standard of these animals leads to an enormous wastage and any improvement that can be effected in their efficiency will also lead to an improvement in the economic condition of the people. Given an alliance between animal husbandry, agricultural and public health workers, which will ensure an adequate supply of sires of a good milking strain, better cropping of the land, and the dissemination of suitable propaganda, this should, in a comparatively short space of time, result in the greater consumption of milk and its products by the human population, and part of the cycle urged by Mr. Bruce would then have been effected, but it is very doubtful if any amount of propaganda will convince the ryot that it would pay him better to grow fodder crops to feed animals which at the moment, are giving him no return for his money, instead of utilizing the land for the cultivation of cash crops or food for his family. From the time when man first took up a pastoral occupation it has been the custom to look upon grazing as the natural way for domesticated animals to obtain their food, and in the case of young animals, which will one day grow into bullocks, the ryot has science on his side. In our view, therefore, the solution of the problem of feeding India's live-stock is largely a question of the extension and improvement of the grazing areas, and this unfortunately is where human and animal interests clash. With the rapid increase in the human population the demand for cultivable land is very great, grazing lands are being taken up for this purpose, and nothing is being offered in exchange for the young stock of the country. It is true that some improvement might be effected by the introduction of controlled breeding amongst animals in these areas, and the necessity for this must not be lost sight of, but the same might be said of the human population, and it seems that the time has come when steps should be taken

to investigate the grazing requirements of the country and decide on the action necessary for providing them.

This having been done, it should be comparatively easy to arrange for the improvement and better utilization of recognised grazing areas, so that they may provide a cheap and efficient working bullock, which, after all, will be the most important factor in any attempt to improve the economic condition of the Indian ryot for very many years to come.

AN EXAMINATION OF AN ANALYSIS OF A SERIAL EXPERIMENT

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THE importance of carrying out trials of new strains of commercial crops or new agronomic treatments in such a way as to provide information from which generalised conclusions can be drawn is obvious to all agricultural workers. The best method of analysis of data from a series of trials carried out in different seasons or at different centres is, therefore, a matter worthy of serious consideration. Bose [1935] has recently analysed a series of variety tests of oats by a method which appears to us to be open to objection. Our objections fall under two heads: (1) The validity of a combined analysis of variance, (2) The allocation of degrees of freedom.

(1) *The validity of a combined analysis of variance.*— We are indebted to Mr. F. Yates, Chief Statistician, Rothamsted Experimental Station, for pointing out to us (in correspondence, August 1934) the fact that a combined analysis of variance of two or more trials is only valid if the error variances of the individual trials are not significantly different. Where the standard errors were approximately proportional to the mean yields Yates [1933] overcame the difficulty by analysing the logarithms of the yields. In Table I are given mean squares for blocks, varieties and error, and standard error per cent for the mean of five plots for each of Bose's trials separately. The error variances in the different trials differ considerably, and by the z-test the two highest variances (34·5 and 28·7) differ significantly from the two lowest (14·5 and 12·9). A combined analysis is, therefore, open to objection on statistical grounds. Inspection of the standard errors per cent shows that Yates' device of equalising the variances by taking the logarithms of the yields would not work in this instance. Other workers [Paterson, 1933; Immer, 1934] have also overlooked the bearing of differences in variance on the technique to be adopted in analysing multiple trials. As it is a matter of great practical importance, it is proposed to discuss more fully elsewhere the methods of analysis available for use in such cases.

TABLE I

Mean squares for blocks, varieties and error, and per cent standard error for individual yield trials of oats at Pusa and Karnal

	Degrees of freedom	Pusa			Karnal		
		1931-32	1932-33	1933-34	1931-32	1932-33	1933-34
Blocks . .	4	349·8	28·7	121·4	90·4	198·1	491·8
Varieties . .	12	180·0	512·9	374·8	113·7	435·7	97·4
Error . .	48	20·6	28·6	14·5	34·5	18·4	12·9
S. E. per cent for mean of 5 plots		7·0	5·1	3·3	7·0	4·4	3·8

(2) *The allocation of degrees of freedom.*—For the purpose of discussing the method of statistical reduction used, we shall ignore the differences in variance in the different trials, and assume that a combined analysis is statistically permissible. Bose regards the combined trial as composed of five blocks repeated at each of two places, and in each of three seasons, each block containing thirteen varieties, and he has accordingly partitioned the variance as follows :—

Component	Degrees of freedom
1. Blocks	4
2. Localities	1
3. Seasons	2
4. Varieties	12
Interactions	
5. Blocks × localities.	4
6. Blocks × seasons	8
7. Blocks × varieties	48
8. Seasons × localities	2
9. Varieties × seasons	24
10. Varieties × localities	12
11. Localities × seasons × varieties	24
12. Localities × seasons × blocks	8
13. Localities × blocks × varieties	48
14. Seasons × blocks × varieties	96
15. Residual error	96
16. Total	389

On this basis, the residual error is, of course, the fourth degree interaction, varieties × seasons × localities × blocks. A serious error has arisen as the result of a misinterpretation of the significance of blocks. The trial does not consist of five blocks repeated at each of two places and in each of three seasons, but of thirty blocks distributed in two places and three seasons. It cannot be too strongly emphasised that " Block 1 " in one place in one season is in no way homologous with " Block 1 " in any other place, or any other season. The distribution of soil heterogeneity within each block is unknown, and independent randomisations of the component plots should be used. Snedecor [1934] has illustrated the same point and for such a series he uses the term " unordered classification ". In our opinion it is preferable in such trials to avoid all possibility of confusion by numbering the blocks consecutively (in the present instance, 1-30).

The allocation of the degrees of freedom can be done quite simply by summation over the six trials, as follows :—

Due to	Degrees of freedom per trial	Number of trials	Degrees of freedom in combined analysis	Subdivided as due to	Degrees of freedom
Blocks . .	4	6	24		
Varieties . .	12	6	72	Varieties . .	12
				Varieties × localities	12
				Varieties × seasons	24
				Varieties × seasons × localities.	24
Varieties × Blocks (= error).	48	6	288		
Between trials .	..	..	5	Localities . .	1
				Seasons . .	2
				Localities × seasons	2
Total .	64	..	389		

Regarding the thirty blocks as a single unordered classification, items 5, 6, 12, 13, 14 and 15 of Bose's classification become meaningless. The sums of squares corresponding to items 5, 6 and 12 are included in the sum of squares due to blocks, and those corresponding to items 13, 14 and 15 in that due to varieties × blocks (= error).

In Table II is given the analysis of variance with the degrees of freedom allocated as above. In compiling Table II the total sums of squares given in the last

column of Bose's Table II have been used. All other calculations were made independently, and the figures obtained agree with those obtained by suitable summations from Bose's table of the analysis of variance, except that the sums of squares in our items 1, 5, 6 and 9 differ from Bose's by 10. These appear to be due to small errors in Bose's calculations.

TABLE II

Combined analysis of variance for trials of varieties of oats at Pusa and Karnal

Due to	Degrees of freedom	Sums of squares	Mean squares	½ $\log_e$	Comparison with error variance	
					z	P
1. Blocks . .	24	5120·8	213·4	2·6816	1·1452	
2. Varieties . .	12	12297·2	1024·8	3·4662	1·9298	
3. Varieties × localities	12	1314·2	109·5	2·3480	0·8116	
4. Varieties × seasons	24	3839·0	160·0	2·5376	1·0012	
5. Varieties × localities × seasons.	24	3123·5	130·1	2·4341	0·8977	In all cases less than 0·01.
6. Varieties × blocks (= error).	288	6220·2	21·6	1·5364		
7. Localities . .	1	345·4	345·4	2·9223	1·3859	
8. Seasons . .	2	14475·3	7237·6	4·4435	2·9071	
9. Localities × seasons	2	5945·6	2972·8	3·9987	2·4623	
Total . .	389	52681·2				

The order of the items in Table II is the same as that used in the allocation of degrees of freedom given above, to facilitate comparison.

It will be noted that the error variance differs very little in magnitude from that given by Bose. This is to be expected, since he took as his error mean square one of the four parts into which he divided the varieties × blocks variance, and the part which he took has a high number of degrees of freedom, and large random fluctuations are therefore not likely to occur. Even so, the reduction in the number

of degrees of freedom on which his estimate of error is based reduces the **accuracy** of his comparisons. We have worked out the values of z for $P = 0 \cdot 01$ where $n_1 = 1$ and $n_2 = 288$ and where $n_1 = 24$ and $n_2 = 288$, and for the corresponding cases with Bose's estimate, where $n_1 = 1$ and $n_2 = 96$ and where $n_1 = 24$ and $n_2 = 96$.

n_1	n_2	z when $P = 0 \cdot 01$	Percentage increase in z
1	288	0·9529	..
1	96	0·9663	1
24	288	0·3086	..
24	96	0·3434	11·1

Where $n_1 = 24$ the reduction in the number of degrees of freedom from 288 to 96 has caused a reduction of 11 per cent in the accuracy of the comparison. This is sufficiently serious, but if there had only been (for example) four varieties in the comparison, Bose's method would reduce the number of degrees of freedom on which the error variance is based from 72 to 24, which would reduce the accuracy of comparison very seriously indeed.

Bose concluded that blocks had not significantly affected the accuracy of the comparison, since the mean square due to blocks (4 degrees of freedom) was not significantly greater than that due to error. His mean square, however, is not the mean square due to blocks, but that due to means of six blocks, one in each trial. The mean square due to blocks (24 degrees of freedom) given in our Table II is greater than that due to error by a highly significant amount. This is borne out by the individual analysis, which showed that the mean square due to blocks was significantly greater than that due to error in five out of the six trials.

Bose's calculation of the improvement in precision due to the method of analysis (*loc cit*), is devoid of all meaning, since he takes the ratio of his error mean square to the total mean square *including the contributions of variety, season and locality* which the trials were designed to investigate. The only controlled factor in the trials which affects their precision is the block effect, and the proper estimate of the improvement in precision due to the elimination of the block effect is the ratio of the error variance to the variance calculated from the sum of squares due to error *plus* that due to blocks.

To facilitate discussion of the criticisms made, a table of yields of the varieties under trial has been compiled (Table III). Varieties are given in the order of total yield over all trials. Yields significantly higher than the mean yield of all varieties in the same trial are printed in heavy type. Yields higher, but not significantly higher than the mean yield in the same trial are printed in italics, and yields significantly lower than the mean yield in the same trial are printed within brackets.

TABLE III

Mean yield per plot of varieties of oats in trials at Pusa and Karnal

Variety	Pusa			Karnal		
	1931-32	1932-33	1933-34	1931-32	1932-33	1933-34
M	*32·2*	**57·2**	**63·8**	35·6	**57·5**	**50·6**
L	**44·3**	**52·3**	**59·5**	(31·8)	**55·9**	*43·7*
C	(24·4)	**59·1**	**67·9**	*42·1*	**47·7**	*43·7*
J	*31·8*	**56·7**	**56·1**	**44·3**	**53·7**	*42·1*
G	*30·2*	**54·4**	**56·1**	**43·7**	**50·2**	*43·6*
E	*30·9*	46·3	*54·1*	35·7	*43·6*	*42·7*
D	26·3	45·1	49·9	*40·6*	*43.5*	41·0
F	**34·8**	*50·3*	(45·4)	34·4	(37·5)	41·9
I	(23·3)	**53·7**	50·8	32·8	(35·6)	*43·3*
K	27·2	(37·2)	(45·8)	*39·4*	(38·5)	40·3
A	25·5	(34·0)	(47·3)	*41·3*	(36·6)	*43·4*
H	(22·2)	(34·0)	(48 5)	36·5	(36·0)	(36·8)
B	(24·7)	(29·4)	(34·9)	(29·3)	(26·1)	(31·2)
General mean	29·1	46·9	52·3	37·5	43·3	41·9
Significant diff. from general mean.	4·2	5·0	3·5	5·4	4·0	3·3

As a combined analysis is not justifiable, such a table of the results of individual analysis can be used as the basis for drawing conclusions, and we believe that the questions to which an agricultural officer usually requires an answer from such trials can be answered from it without the aid of the combined analysis. The information required may be summed up in the following questions :

(1) Which are the best varieties under the conditions of the trials ?

(2) Which varieties, if any, have given consistently good yields throughout the range of conditions sampled, *i.e.*, two places, and three seasons ?

The answer to the first question is the same as that given by Bose, namely that the best varieties are M, L, C, J and G. In uniformity of behaviour (the second question) J, G and M were considerably better than L and C. All three exceeded the mean by significant amounts in four out of six trials. In the remaining trials J and G exceeded the mean in both, and M exceeded it in one and fell slightly below it in one. L and C, on the other hand, each yielded significantly less than the mean in one trial, and must therefore be regarded as somewhat uncertain in behaviour. L, however, gave significantly higher yields than the mean in all trials at Pusa, and it must always be remembered that whereas a variety must yield satisfactorily in

the face of all variations of season, success in localities in different agricultural tracts is not necessary, since it can be confined to the tract to which it is suited.

We do not agree with Bose that it is not very desirable to reject treatments or varieties on the basis of a single year's data. The Indian cultivator lives with such a small margin that he cannot afford to adopt any treatment or variety, however good on the average, if it is liable to fall markedly below the average under some conditions. There is, therefore, a good deal to be said for discarding any variety or treatment which in any year falls significantly below the standard adopted, unless there is reason to believe that it may have been adversely affected by more or less accidental causes, such as loss of germinating power of the seed used.

In giving up the combined analysis, the direct comparisons (1) between localities, and (2) between seasons ; and the interactions (1) between locality and season, (2) between variety and locality and (3) between variety and season have been lost. It is our opinion that in trials designed to determine the most suitable variety for a tract, all the necessary information can be obtained from a study of such a table as Table III. Where statistical tests of significance are required of varietal differences over a series of trials, or accurate information is desired on locality and season effects, the method of weighted squares of means can be used, and the significance of interactions tested by Yates' Q test [Yates, 1934]. These will be discussed in more detail in a subsequent paper.

SUMMARY

(1) We have shown that the error variances of the component trials in Bose's serial experiment differ significantly, and a combined analysis of variance is therefore not permissible.

(2) We have discussed Bose's partition of the degrees of freedom and shown that he has misunderstood the significance of blocks. We have re-apportioned the degrees of freedom and carried out the analysis in the correct manner assuming homogeneous error variances.

(3) We have discussed the interpretation of the results of analyses of variance of the component trials, and shown that conclusions can be drawn from them with almost as much confidence as from the combined analysis. For a suitable method of combining data from trials with different error variances, the reader is referred to Yates [1934].

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ON AN ATTEMPT TO USE HAND-SPINNING FOR TESTING QUALITY IN COTTON

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From a critical examination of the data accumulated at the Indian Central Cotton Committee's Technological Laboratory, Bombay, and at the Shirley Institute, Manchester, Turner and Underwood [1934] concluded that the commonly measured hair characters were inadequate for the accurate prediction of spinning value. Of the characters examined, hair-length and hair-weight show the highest correlations with spinning value, but in more than fifty per cent of cases the deviation from the spinning value predicted from these two characters was greater than ten per cent [Turner and Venkataraman, 1933]. Two strains, developed at the Institute of Plant Industry, provide a typical illustration of this discrepancy. Comparable data for these strains, averaged over four seasons, are given below :—

Character	M1	M9	M9/M1
Mean hair length (ins.)	0·78	0·81	
Mean hair weight (10^{-6} oz.)	0·192	0·202	
Highest standard warp counts	..	..	Per cent
Actual	12·7	16·1	133
Predicted (formula 16)	20·8	22·2	107
(formula 17)	22·2	22·7	102

Predicted spinning values have been calculated from two prediction formulae involving hair-length and hair-weight only, given by Turner and Venkataraman [1933]. Not only are the predicted values very much higher than the actual values, but the superiority (33 per cent) of M9 over M1 is hardly reflected in the calculated values.

For the plant breeder, it is of the utmost importance that spinning value shall be determined at the earliest possible point in the breeding of his strains, and the inefficiency of predictions from hair characters leaves him at present with no alternative to a direct spinning test. For a satisfactory test even under Technological Laboratory conditions, however, at least a ten—pound sample of lint is necessary and such a quantity is not available until the most important breeding stages have

been passed and the bulk of the selection work done. Selection on actual spinning value can, therefore, only be carried out on a small number of strains which have survived to the stage of growing in bulk.

Samples of lint, as small as the produce of a single plant, can be hand-spun on the *takli* or the *charkha*. Experiments were carried out to discover whether such hand-spun yarns could be used to obtain an accurate estimate of the value of a sample for machine-spinning.

A *takli* was used in experiment I. It is a thin iron rod about 6 inches in length with a copper or brass disc of the size of a pice fixed about half an inch from one end. The other end is pointed and hooked and is used for drawing the yarn. After drawing a length of yarn the spinner gives the *takli* a brisk revolving movement and when he feels that the yarn is sufficiently twisted he stops the *takli* and winds the yarn just above the disc. Percentage errors were low by this method, but the process is slow and the spinner took about four hours to make one lea-length (120 yards) of yarn. There is also no objective control of the twist in this method of spinning. Subsequent trials were, therefore, carried out with the *charkha* or the Indian spinning wheel. A definite number of revolutions of the wheel after drawing a length of yarn ensured a reasonably uniform twist. Spinning was quicker and a lea-length could be obtained in about two hours. Throughout the experiment the spinner was instructed to use the same care and skill on each sample in the hope that, in consequence, differences between samples in spinning value would be reflected in differences both in count and in strength.

Prepared leas (one per sample) were tested for strength at a local mill and the data for counts, strength and counts adjusted for regression on strength were analysed. Results are given in Tables I to III.

Spinning was done in sets, each set including one sample from each strain under test. Samples in a set were spun in random order. In the analysis of variance differences between sets were eliminated in the same way as differences between blocks are eliminated in an agricultural experiment of randomised block design. It is of interest to note that in most cases this resulted in a marked improvement in the accuracy of the experiment.

There is no control of humidity in the testing room of the mill where the samples were tested and no record of the prevailing humidity is available. Samples belonging to one experiment were, however, tested on the same date and when the number of samples was large, whole sets were tested simultaneously. This ensured that each set was tested at the same humidity. This was all that was needed, since only comparative data on yarn strength were required.

TABLE I

Analyses of variance of counts and strength of Malvi 1 and Malvi 9

Experiment II, *charkha*-spun

Due to	Counts				Strength			Counts corrected for strength			
	Degrees of freedom	Mean sq.	z	P	Mean sq.	z	P	Degrees of freedom	Mean sq.	z	P
Sets	5	2·58	1·22	0·01	4·2	0·14	high				
Strains	1	3·25	1·34	0·01 (approx.)	33·0	0·89	$>0·05$	1	2·51	1·50	0·01 (approx.)
Error	5	0·22			5·6			4	0·125		

	Mean values				
	Malvi 9	*Malvi* 1	Standard error	Significant difference	Standard error per cent
Counts	19·6	18·6	0·19	0·7	1·01
Strength	36·7	33·3	0·97	..	2·76
Counts corrected for strength	19·7	18·5	0·14	0·6	0·76

Percentage errors were slightly higher with the *charkha* than with the *takli* but were still quite low. *Malvi* 9 gave a significantly higher count than *Malvi* 1 both before and after correction for regression on strength. This was a promising result, though the counts were somewhat lower than with the *takli* and the difference between the two strains smaller.

Finer spinning was attempted in the third trial (Table II) because it was thought that with higher counts the difference between strains would increase.

TABLE II

Analyses of variance of counts and strength of yarns of Malvi 1 and Malvi 9

Experiment III, *charkha*-spun to higher counts

Due to	Counts				Strength			Counts corrected for strength			
	Degrees of freedom	Mean sq.	*z*	*P*	Mean sq.	*z*	*P*	Degrees of freedom	Mean sq.	*z*	*P*
Sets . . .	5	5·07	0·008	high	8·8	0·44	>0·05				
Strains . .	1	0·55	1·12	high	44·0	1·25	<0·05	1	3·69	0·21	High
Error . . .	5	5·15			3·6			4	5·63		

	Mean values				
	Malvi 9	*Malvi* 1	Standard error	Significant difference	Standard error per cent
Counts	23·1	22·6	0·93	. .	4·06
Strength	33·7	29·8	0·77	2·3	2·44
Counts corrected for strength	23·9	21·8	0·97	. .	4·24

The spinner succeeded in obtaining finer counts but the experimental errors increased considerably and differences in counts either corrected or uncorrected were not significant.

In the final experiment the spinner was instructed to work as in experiment II and not to make any special effort to spin high counts.

Experiment V was carried out on *Malvi* 9 and five sub-strains of it all grown in the same field in the hope of being able at least to estimate the relative spinning values of closely related closely strains grown under closely similar conditions (Table III).

TABLE III

Analyses of variance of counts and strength of charkha-*spun yarns of six Malvi 9 strains*

Experiment V

Due to	Counts				Strength			Counts corrected for strength			
	Degrees of freedom	Mean sq.	z	P	Mean sq.	z	P	Degrees of freedom	Mean sq.	z	P
Sets	2	4 13	0·97	0·01 (approx.)	70·5	0·80	$<0·05$				
Strains	5	0·40	0·19	High	7 2	0·34	High	5	0·40	0 17	High
Error	10	0·59			14·3			9	0·56		

	Mean values								
	M9-13	M9-bulk	M9-17	M9-15	M9-20	M9-19	Standard error	Significant difference	Standard error per cent
Counts	20·0	19·9	19·6	19·5	19·4	19·0	0·445	.	2·28
Strength	47·7	48·7	45·7	46·3	46·3	49·7	2·18	. .	4·60
Counts corrected for strength.	20·0	19·8	19·7	19·6	19·4	18·8	0·432	. .	2·21
Highest standard warp count Tech. Lab.	20	16	22	15	21	13			

Percentage errors were fairly low, but all differences were insignificant. Spinning values obtained from the Technological Laboratory spinning tests are included in the Table for comparison, and range from 13 for *Malvi* 9-19 to 22 for *Malvi* 9-17. The range for hand-spinning is only from 18·8 to 20·0 and the individual values bear no relation to those obtained by machine-spinning.

At first sight, spinning very small samples by hand appears a promising method of estimating the spinning quality of a cotton breeder's material at an early stage. The low errors obtained in preliminary tests gave further encouragement. Comparison with the results obtained from the same material in Technological Laboratory spinning tests, however, shows conclusively that the factors controlling machine-spinning value and hand-spinning value differ so greatly that there is no correlation between the two. The method is therefore without value to the breeder, who is interested only in machine-spinning value. The urgency of the plant breeder's need for a method of determining the spinning value of small samples is such that it seems to us probable that others will turn to hand-spinning as a possible solution, and for this reason we think it desirable to record the results of our attempt.

Acknowledgments

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Summary

Samples of cotton were hand-spun on the *takli* and the *charkha* and the count and strength of the yarns estimated. The results obtained were compared with those from spinning tests carried out at the Technological Laboratory. There was no agreement between the data for hand and machine-spinning, and it is concluded that hand-spinning is of no value in estimating the quality of cotton for mill use.

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FACTORY CANE-MOLASSES AS A CATTLE FEED

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Introduction

Previous experiments conducted at Lyallpur with cane-molasses obtained from "Khandsari" (open-pan system of manufacturing white sugar), the results of which were published in *Agriculture and Live-stock in India* [Labh Singh, and Sodhi, 1934 ; 1935] had shown that—

(1) Two lbs. of molasses replaced two lbs. of maize in a mixed ration for working bullocks per animal per diem in winter without any detrimental effect on live-weight and health provided the animals are allowed free access to common salt.

(2) There was no detrimental effect of feeding cane molasses to bullocks in winter, on their health in the following summer and afterwards.

(3) Molasses affect the health of animals adversely if fed in summer.

The publication of these results aroused considerable interest in cane-molasses as a cattle feed. Several enquiries were received in which it was asked whether the factory (vacuum pan) molasses could be used as a cattle feed. To answer such enquiries and to know the food value for bullocks of factory cane-molasses which is produced in very large quantities, an experiment was carried out, the results of which are given in the present paper.

MATERIAL AND METHOD

Molasses used in this experiment was obtained from a local refinery, which manufactures white sugar from *gur* (jaggery). The result of chemical analysis of the molasses used in the experiment is given below :—

	Per cent
Dry matter	74·6
Ash	6·86
Soluble carbohydrates	66·69
Fibre	*Nil*
Fat	*Nil*
Protein	1·05
Moisture	25·4

Chemical analysis of ash which was 6·86 per cent of molasses is recorded below :—

K_2O	2·770
SO_3	0·718
CaO	0·675
MgO	0·186
Na_2O	0·146
Fe_2O_3	0·088
P_2O_5	0·059
Mn_2O_4	0·002
Insoluble residue	0·125

Sixty bullocks are kept at the Government Experimental Farm, Lyallpur. Out of this number twenty-four bullocks were selected and divided into two groups, namely " A " and " B " in such a way that they (groups) were comparable, with regard to their age, live-weight and breed, etc. The average live-weight per bullock at the commencement of the experiment is given below :—

	lbs.
Group A.—(which was fed on molasses)	1,078
Group B.—(control) which received 2 lbs. of maize in place of 2 lbs. of molasses	1,070

A pair was made by taking one bullock from each group when the animals were taken out for work. In this way both the groups did exactly the same work. Work done by bullocks was recorded daily and is given in Table II. Actual time spent on work was not recorded. On the other hand, work done was

recorded daily. It was converted into working days using the following standards :—

Standards of work for one pair of bullocks

Serial No.	Operation	Amount	Time (day)
1	Ploughing	1 acre	1
2	Sohagaing	4 acres	1
3	Horse-hoeing cultivation	3 ,,	1
4	Horse-hoeing interculture	3 ,,	1
5	Bar harrow	4 ,,	1
6	Pore (one share drill) for sowing wheat . .	1 ,,	1
7	*Rabi* drill	3 ,,	1
8	Automatic drill	4 ,,	1
9	*Kharif* drill	3 ,,	1
10	*Kera* with *Munah*	1 ,,	1
11	*Karaha* on bunds only	2 ,,	1
12	Carting manures	6 cartlodes from a distance of ½ mile.	1
13	Harvesting of wheat with reaper	2½ acres	1
14	Thrashing of wheat	½ ,,	1
15	,, *toria*	1 ,,	1
16	,, gram	1 ,,	1
17	Cane crushing	12 Mds. cane.	1
18	Grinding wheat	4 Mds.	1
19	,, maize	2 ,,	1
20	,, *dal*	6 ,,	1

These standards have been formed as a result of long experience at the Government Farm, Lyallpur. The amount of work given above is generally taken from one pair of bullock per day. The days of work are, therefore, computed and not actual; but this makes no difference so far as the experiment is concerned because it is the same for both the groups.

Bullocks were weighed for four days just before the experiment was started and the weighing was repeated after every ten days, *viz.*, on the last four days of each fortnight. The average results are reproduced below :—

TABLE I

Year 1934-35

Serial No. of fortnight	Live-weight in lbs. per animal		
	Bullocks getting 2 lbs. of molasses each in addition to basal ration	Bullocks being fed on ordinary ration and getting no molasses	No. of working days per animal per fortnight
At the commencement of the experiment.	1078	1070	..
At the end of—			
1st fortnight	1083	1063	12·9
2nd ,, ...	1090	1080	7·5
3rd ,, ...	1087	1072	3·8
4th ,, ...	1114	1100	5·4
5th ,, ...	1110	1094	5·2
6th ,, ...	1107	1096	4·2
7th ,, ...	1094	1089	7·1
8th ,, ...	1077	1065	10·7
9th ,, ...	1077	1071	8·0
10th ,, ...	1079	1067	7·5

For details reference may be made to Table III.

Weighing was done on a weigh-bridge early in the morning before feeding and watering the animals.

The bullocks under the experiment were fed according to the farm routine, time table of which is given below :—

3-45 P.M.	Roughages
4-30 P.M.	Concentrates
7-30 A.M.	Watering
3-30 P.M.	Watering

During the interval between 7-30 A.M. and 3-30 P.M., bullocks were taken out for work or for exercise to a paddock where there is practically no grazing. Roughages fed to both the groups are given below :—

Year 1934-35

Serial No. of fort-night	Dates	Name of green fodder	Name of dry fodder	Ratio of green fodder to dry fodder
1	17th Nov. to 30th Nov. .	Maize and *toria* (*Brassica napus*).	Wheat *bhusa*	2·9 : 1
2	1st Dec. to 14th Dec. .	*Toria* (*Brassica napus* and *sarson* (*Brassica campestris*).	,,	2·9 : 1
3	15th Dec. to 28th Dec. .	*Raya* (mustard) and *sarson* (*Brassica campestris*).	,,	2·0 : 1
4	29th Dec. to 11th Jan. .	*Sarson* (*Brassica campestris*) and berseem	,,	2·5 : 1
5	12th Jan. to 25th Jan. .	*Sarson* (*Brassica campestris*)	,,	2·5 : 1

Serial No. of fort-night	Dates	Name of green fodder	Name of dry fodder	Ratio of green fodder to dry fodder
6	26th Jan. to 8th Feb. .	Berseem and *sarson* (*Brassica campestris*).	Wheat *bhusa*	2·5 : 1
7	9th Feb. to 22nd Feb. .	Berseem and *senji* (Melilotus).	,,	1·5 : 1
8	23rd Feb. to 8th March .	Berseem and Russian *rai* .	,,	2·5 : 1
9	9th March to 22nd March .	Wheat, Russian *rye* and *senji* (Melilotus).	,,	2·5 : 1
10	23rd March to 5th April .	Berseem and oats . .	,,	3·5 : 1

Roughages were weighed daily for each group. The residue left was weighed next morning. The quantities of roughages consumed by each group are given in Table IV.

Group A was given two lbs. of molasses in addition to a basal ration of concentrates. Group B was fed on the same basal ration of concentrates *plus* two lbs. of maize. Basal ration of concentrates consisted of two parts of crushed gram and one part of crushed shrivelled wheat grains. The quantities of concentrates fed per bullock per day during the experimental period are given below :—

Period	Group A	Group B
First four fortnights (17th Nov. 1934 to 11th Jan. 1935).	3 lbs. of grain mixture, 2 lbs. of molasses.	3 lbs. of grain mixture, 2 lbs. of maize.
Remaining six fortnights (12th Jan. 1935 to 5th April 1935).	2 lbs. of grain mixture, 2 lbs. of molasses.	2 lbs. of grain mixture, 2 lbs. of maize.

Concentrates were fed to each bullock individually. Molasses was mixed with grain mixture. Concentrates were not mixed with roughages but they were given separately in iron buckets to insure that each animal consumed his full share. One lump of common salt was placed between every two bullocks so that they might have a lick at it whenever they liked.

Duration of the experiment

The experiment was started on the 17th of November 1934 and concluded on the 5th of April 1935. The experimental period thus covered ten fortnights or 140 days only. The results obtained would have been more reliable had the experimental period been longer but unfortunately it was not possible because previous experiment had shown that molasses was not fed in summer at Lyallpur without affecting the health of the animals adversely.

The main object of the experiment was to see if a farmer could replace a starchy food such as maize in a mixed ration which he usually gives to his working animals in winter without any detrimental effect. Maize, whenever available, forms a part of the concentrates fed to the farm bullocks. Two lbs. of maize in a mixed ration of this kind were replaced by two lbs. of factory molasses.

Nitrogen balance could not be determined in an experiment of this nature. The authors, however, feel that if an experiment of this nature under more controlled conditions is carried out and nitrogen balance also determined it will be of great value to farmers.

Discussion of results

(1) The details of roughages consumed are given in Table IV. On an average group A which was given two lbs. of molasses per head daily consumed 40·16 lbs. of roughages per day per thousand lbs. live weight and group B which received two lbs. of maize instead of two lbs. of molasses consumed 40·38 lbs. Thus group A consumed ·22 lbs. of roughages per day per thousand lbs. live weight more than group B. The consumption of roughages has therefore been on the whole equal in the two groups and molasses has not affected it adversely.

(2) It would be seen from Table I that live weight has been well maintained on the rations under trial for 140 days. The live weight per animal of group A and group B at the commencement of the experiment was 1,078 lbs. and 1,070 lbs. respectively. At the end of the experiment it was 1,079 lbs. and 1,067 lbs. for groups A and B respectively. There was a slight reduction in the live weight at the end of 8th fortnight in both the groups. This was probably due to hard work to which the animals were put during this period. Excepting the first fortnight the number of working days was highest during this fortnight.

(3) The same basal ration *plus* two lbs. of factory molasses in one case and two lbs. of maize in the other has maintained the live weight of twenty-four bullocks (twelve bullocks received molasses and twelve bullocks maize) for 140 days. It, therefore, indicates that two lbs. of factory cane-molasses could replace two lbs. of maize in a mixed ration for working bullocks in winter.

(4) The health and condition of the bullocks were constantly watched during the experiment and for fourteen months afterwards. No ill effect was observed.

Summary

Twelve bullocks were fed on two lbs. of factory molasses and twelve on two lbs. of maize for 140 days (in winter from 17th November to 5th April), basal ration being the same in both the cases. They were put to the same work throughout the experimental period. The live weight of the animals was well maintained. No ill effect of feeding factory molasses was observed on the health of the animals during the experimental period and for fourteen months afterwards. It therefore indicates that two lbs. of factory molasses could replace two lbs. of maize in a mixed ration for bullocks in winter season.

Acknowledgment

The authors are indebted to Dr. P. E. Lander, Agricultural Chemist to Government, Punjab, for analysing molasses and to Mr. Nathu Ram, Farm Manager, Lyallpur, for general assistance.

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TABLE II

Showing the number of working days for each pair of bullocks for each fortnight (1934-35)

Serial No. of fort-night	Dates	Number of working days of each pair of groups A & B												Total No. of working days of groups A & B	Average No. of working days of groups A & B
		1	2	3	4	5	6	7	8	9	10	11	12		
1	17th November to 30th November	13	12½	12	13	14	11	13	12	13½	13½	13½	13½	154½	12·9
2	1st December to 14th December	12	4	11	8	5½	4	8½	13	8½	7	5	4	90½	7·5
3	15th December to 28th December	8	1	7½	3	...	1	1	6	5	6	5	2	45½	3·8
4	29th December to 11th January	11	1	10	4	3	3	5	11	6¾	4½	3¾	2½	65½	5·4
5	12th January to 25th January	7	4	7	...	6	9	...	7	8	4	7	3	62	5·2
6	26th January to 8th February	6	1	10	6	...	3	...	10	5	4	4	1	50	4·2
7	9th February to 22nd February	9	8	10½	8¾	6½	6½	7	12	5¾	4½	6	1½	85¾	7·1
8	23rd February to 8th March	13	9	13	13	11	11	8	13	12	12	8	5	128	10·7
9	9th March to 22nd March	9	7	12	12	9	5	8	10	7½	7½	5	4	96	8·0
10	23rd March to 5th April	10	10	1	10	8	6	5	13	9½	2½	11¾	3½	90½	7·5

TABLE

Showing the fortnightly live-weights of

Serial No. of fortnight	Dates on which bullocks weighed (1934-35)	Live weight 1		2		3	
		Mds.	srs.	Mds.	srs.	Mds.	srs.
In the beginning of experiment.	17th November to 20th November	12	20	12	12	13	31
At the end of—							
First fortnight	1st December to 4th December	12	20½	12	12	13	24½
2nd ,,	15th December to 18th December	12	30½	12	9½	14	2
3rd ,,	29th December to 1st January	12	22½	12	1½	13	27½
4th ,,	12th January to 15th January	12	28	12	18	14	11½
5th ,,	26th January to 29th January	12	14½	12	9½	14	0
6th ,,	9th February to 12th February	12	20	12	22	13	39
7th ,,	23rd February to 26th February	12	28½	12	24¾	13	39
8th ,,	9th March to 12th March	12	12½	12	11½	13	32½
9th ,,	23rd March to 26th March	12	16¾	12	10	13	30
10th ,,	6th April to 9th April	12	20½	12	8½	13	29½

TABLE

Showing the fortnightly live-weights of bullocks

Serial No. of fortnight	Dates on which bullocks weighed (1934-35)	Live weight 1		2		3	
		Mds.	srs.	Mds.	srs.	Mds.	srs.
In the beginning of experiment.	17th November to 20th November	12	17	12	1½	12	34
At the end of—							
1st fortnight	1st December to 4th December	12	15	11	30¾	12	29½
2nd ,,	15th December to 18th December	12	21½	11	33	12	30
3rd ,,	29th December to 1st January	12	16	11	33	13	2½
4th ,,	12th January to 15th January	12	18¾	11	38	13	19
5th ,,	26th January to 29th January	12	9	12	4	13	10
6th ,,	9th February to 12th February	12	23	12	9½	13	12½
7th ,,	23rd February to 26th February	12	21	12	¾	13	12½
8th ,,	9th March to 12th March	12	9¾	12	1½	12	32
9th ,,	23rd March to 26th March	12	13	11	39	13	¾
10th ,,	6th April to 9th April	12	15	11	35½	13	0

III

bullocks receiving 2 lbs. of molasses each in addition to basal ration (Group A)

of each bullock (average of 4 days)									Average live weight of the group per bullock
4	5	6	7	8	9	10	11	12	
Mds. srs.	Mds. srs.	Mds srs	Mds. srs.	Mds. srs.	Mds. srs.	Mds. srs.	Mds. srs.	Mds. srs.	Mds. srs.
11 16	12 31½	13 14½	15 21½	11 5½	12 15	13 29½	14 13	14 2½	13 4½
11 18	12 35½	13 12½	15 32	11 8½	12 16½	13 37½	14 17½	14 4	13 6½
11 15	13 5½	13 10½	15 39	11 19½	12 16½	13 15	14 26½	14 10	13 10
11 15	13 0	13 14½	16 ½	11 13	12 12	13 31	14 19½	14 27½	13 8½
11 33	13 6½	13 31	16 18	11 28	12 26½	14 1½	15 6	14 14½	13 22
11 30½	13 11	13 17	16 14	11 32½	12 22½	13 30	14 25	14 14	13 15
12 6½	13 12	13 21	16 2	11 25½	12 22½	13 36	14 31	14 28	13 18¾
12 ½	12 33	13 13½	15 14¾	11 32	12 24½	13 32½	14 12¾	14 11	13 12½
11 30	12 35½	13 3½	15 24	11 7½	12 3	13 28½	14 2	14 11½	13 3½
12 0	12 27½	13 10¾	15 13½	11 11½	12 13½	13 33½	14 0	13 39	13 3¾
11 33	12 27½	13 8½	15 17	11 8¾	12 14	13 31½	14 9½	14 4½	13 4½

III—*contd.*

being fed on ordinary ration and getting no molasses (Group B)

of each bullock (average of 4 days)									Average live weight of the group per bullock
4	5	6	7	8	9	10	11	12	
Mds. srs.	Mds. srs.	Mds. srs	Mds srs.	Mds. srs.	Mds srs	Mds. srs.	Mds. srs.	Mds. srs.	Mds. srs.
11 38½	12 17½	13 25	15 3	10 2½	12 17½	13 34	14 35½	14 13	13 0
12 2	12 16	13 34½	15 8½	9 28	12 24	14 4	14 31½	13 35	12 38
12 11½	12 30	13 35½	15 12½	10 1	12 21	14 7½	15 13	14 8	13 5½
12 15½	12 18½	13 35	14 35	9 34½	12 16	13 37	15 17	13 30½	13 1
12 23	13 18½	14 3½	15 8	10 11	12 30	14 9	15 38½	14 16½	13 15½
12 33¾	13 0	13 34½	15 3	10 2	12 32½	14 10½	16 2½	14 6½	13 12½
12 18½	12 26	13 20½	15 10½	10 6	12 24½	14 24½	16 ½	14 17½	13 13
12 19	13 6½	13 30	14 38	10 11½	12 23¾	14 1¾	15 16	14 14½	13 9½
12 8½	12 18	13 13½	14 25½	10 2	12 14½	13 37½	15 23	14 ½	12 39
11 21¾	12 34½	13 22½	14 20¾	10 5¾	12 17¾	14 7½	15 15	14 10	13 ¾
11 24¾	12 22½	13 21	14 20½	10 4¾	12 15½	13 38	15 32	14 9	12 39¾

TABLE IV

Showing the daily consumption of fodder by bullocks per 1,000 lbs. live-weight

(Year 1934-35)

No. of fortnight	Dates	Consumption of fodder in seers per day					
		Group A bullocks getting 2 lbs. of molasses each in addition to basal ration		Group B bullocks getting 2 lbs. of maize each in addition to basal ration		Difference of consumption of roughages between Groups A and B (*i.e.*, difference between columns 3 and 4 in seers)	
		Roughages	Dry matter	Roughages	Dry matter	Roughages	Dry matter
1	17th November to 30th November . .	21·1	7·38	21·1	7·38	*Nil.*	*Nil.*
2	1st December to 14th December . .	19·4	6·35	19·9	6·50	+0·5	+0·15
3	15th December to 28th December . .	19·9	7·38	20·7	7·74	+0·8	+0·36
4	29th December to 11th January . .	20·9	7·36	21·0	7·40	+0·1	+0·04
5	12th January to 25th January . .	19·8	6·87	19·9	6·89	+0·1	+0·02
6	26th January to 8th February . .	20·5	7·10	20·6	7·12	+0·1	+0·02
7	9th February to 22nd February . .	17·8	7·82	17·6	7·63	—0·2	—0·19
8	23rd February to 8th March . . .	20·2	7·04	19·9	6·93	—0·3	—0·11
9	9th March to 22nd March . . .	20·4	7·55	20·3	7·53	—0·1	—0·02
10	23rd March to 5th April	20·8	7·16	20·9	7·20	+0·1	+0·04
	Average per day per 1,000 lbs. live weight for all ten fortnights.	20·08	7·201	20·19	7·232	+0·11	+0·031

A COMPARISON OF THE INDIGENOUS METHOD OF CAPONIZATION OF COCKERELS WITH THAT UTILIZING SURGICAL INSTRUMENTS

BY

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In the same way that the castration of scrub bulls is the only solution of the indiscriminate breeding problem among cattle, so is caponization the only method by which unwanted cockerels in the village may be economically eliminated.

At present all the cockerels and pullets grow up and forage together and fighting and mating take place long before they attain complete maturity. It is only partially true to say that merely the strongest and most developed of the males perform the mating function, in reality much surreptitious mating between weedy cockerels and immature pullets has been observed.

Another and equally forceful argument in favour of the wholesale practice of caponization is the fact that capons attain a marketable weight in approximately half the time taken by uncaponized males, so that a villager could rear twice the number of fowls for market in the same time and with the same expenditure of labour as with uncaponized birds. The well-known tastiness and tenderness of the capon's flesh is due to the docility of the unsexed bird and the consequent lack of incentive to violent, muscle-producing activity, as well as to the extreme rapidity of the flesh-building process on a soft bone foundation.

That part of India in which caponization is most widely and generally practised is Kashmir, and especially the Lolab Valley. Here professional caponizers go about among the neighbouring villages performing the operation in return for payment in kind. These caponizers are generally farmers who practise the trade as a side-line. If the number of fowls to be caponized is a large one they accept payment at the rate of one fowl out of every ten caponized. In the case of a small number, six seers of maize or rice is considered a suitable remuneration.

The Kashmir method of caponizing

The operator provides himself with a small knife of doubtful sharpness, a needle with two or three cotton threads twisted together, and a small bowl of powdered charcoal. There is also an assistant to hold the fowl to prevent its struggling.

The cockerels themselves have an average age of twelve weeks and weigh approximately one-and-a-half to two pounds.

Squatting on the ground, the operator places the cockerel on its back with tail towards him. The assistant then holds the legs to prevent struggling while the operator places one foot on either wing. Feathers are then plucked away from the abdomen so as to expose the skin in a line about three inches long and one inch broad. He then takes the knife and makes a horizontal slit in the skin of the abdomen about one inch below the point of the sternum. This incision is then enlarged at each end until it is about three inches long. The inner membrane enclosing the intestines is then similarly cut, taking care to do this only during the period of the cockerel's inhalations, otherwise the intestines protrude through the incision with the consequent risk of puncturing.

The operator then lays down the knife and inserts the forefinger of the right hand into the body cavity as far as the spine. (The testicles are located on each side of the back-bone, at the junction of the last two pairs of ribs.)

Then he endeavours to break off each testicle and draw it out on his finger tip. This proves to have an uncertain outcome. Any of the following results may occur to one or both testes :—

(*a*) Successfully withdrawn.

(*b*) Partially withdrawn. This may result in what is known as a "slip." That is, the cockerel would develop the fighting and crowing capacities of an uncaponized male, but without the flesh-developing capabilities of a capon or the fertilizing powers of a cock.

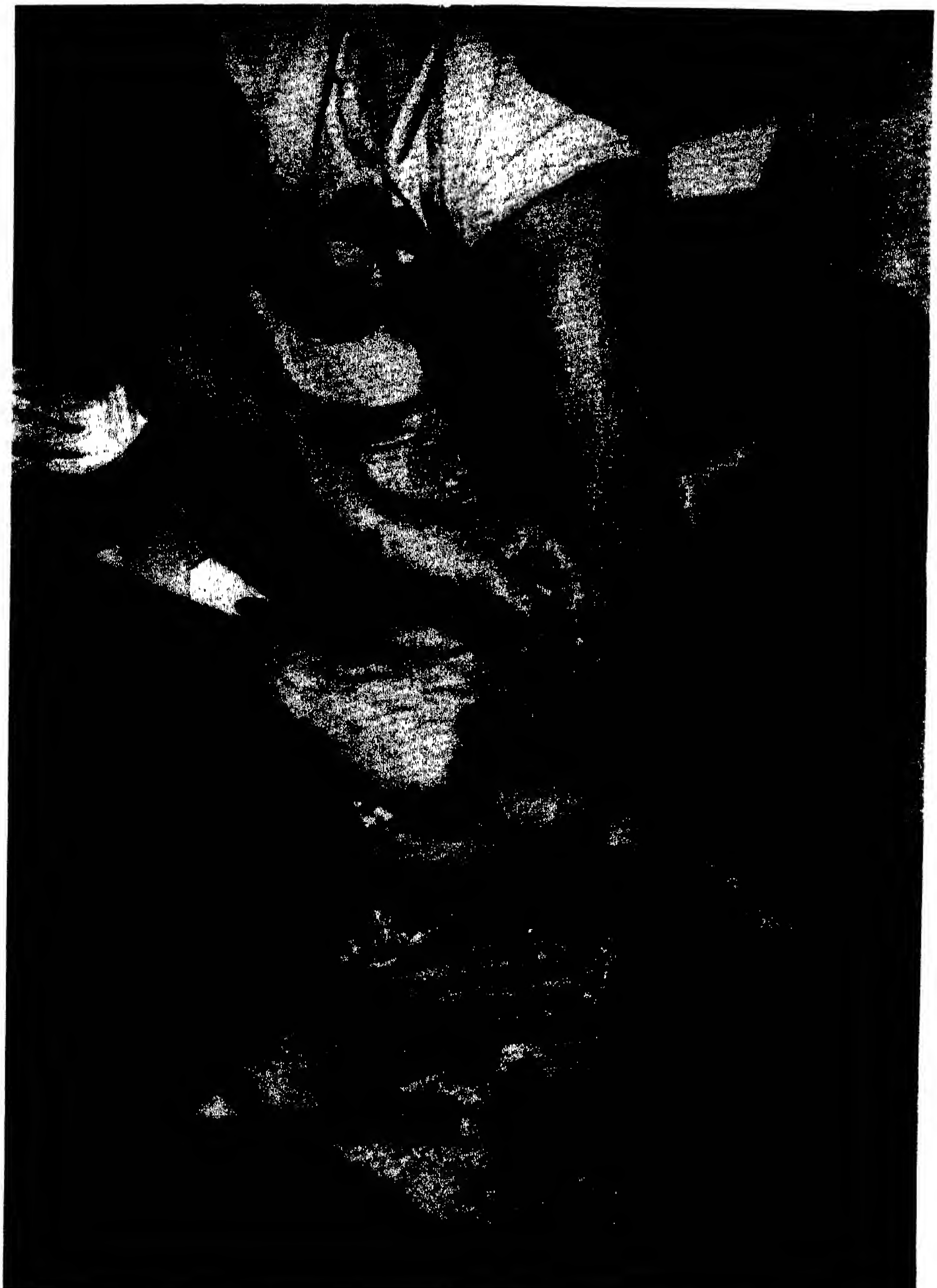
(*c*) Broken and squeezed in the body cavity. This may or may not result in a successful capon. Should any of the tissue remain *in situ* it is probable that the bird would become a "slip" with the characteristics mentioned in (*b*) above.

(*d*) Slipped away into the body cavity. This generally produces a successful capon, but there is the risk of death due to the presence of the loose and decaying organ in the body cavity.

Having dealt with each testicle in one of the ways described above, the operator rubs his finger on the earth to dry the blood, then proceeds to stitch up the wound with the needle and twisted thread, the latter having been dressed with a little of the fowl's blood. This accomplished, he concludes the operation by sprinkling charcoal on the wound and introducing the testicles (if extracted) into the capon's mouth for the bird to eat—this, presumably, by way of reward for the ordeal just undergone.

The average time spent on the operation is twelve minutes per fowl. If the fowls do not eat they are hand fed with grain.

Plates XIV-XVI show (*i*) the incision being made, (*ii*) the insertion of the forefinger, and (*iii*) a testicle successfully extracted.



Making the incision

Locating and breaking off the testicles

Withdrawal of a testicle

The conclusion drawn is that the method is crude and unhygienic and it says much for the hardiness of the fowls that they survive the operation. All that can be said in its favour is that it is cheap in that it requires no special instruments. In regard to cruelty, except for a few protests during the time the incision was being made the fowls were seen to lie quietly on their backs and not to be unduly distressed.

In the main the great objection is the uncertainty of the outcome and this alone would justify the expense of the special surgical instruments which permit a positive operation with the organs in full view all the time.

The method using surgical instruments

The method of caponization using surgical instruments is thus greatly to be advocated. The instruments are inexpensive, costing probably less than Rs. 20 per set. Generally four instruments are included, namely, a small scalpel, a combined hook and probe, a rib-spreader, and an extractor. Complete instructions are given with each set, and these vary only in small detail in accordance with the peculiarities of construction of the various makes of instruments.

Cockerels weighing about one-and-a-half pounds are selected and subjected to a period of starvation of 24 hours with only water to drink. The object of this is to reduce the volume of the contents of the intestines so as to facilitate the operation.

The bird is laid on its side on a table with the wings held back and the legs secured by means of weighted cords. The feathers around the seat of the operation are moistened or plucked so as not to interfere with the cutting process. Using the left hand, the skin is then drawn back towards the hip and an incision made starting about three-quarters of an inch below the end of the dorsal vertebrae and continuing one inch along the line between the last two ribs. (The object of drawing back the skin is to prevent the wound in the skin and the cut in the body cavity from lying in juxtaposition after the operation). The knife should penetrate to a depth of not more than one-quarter of an inch otherwise there would be the danger of injuring the intestines.

The rib-spreader is then inserted and the ribs carefully pushed apart without tearing the flesh. The hook end of the probe is then used to tear the membrane covering the body cavity being careful not to damage the intestines. By pushing back the intestines with the probe, the upper testicle can be seen lying just below the front end of the kidney and close to the backbone. If the upper organ is raised a little the lower one is visible on the other side of the backbone.

Holding the probe in the left hand and the extractor in the right, the latter is opened only sufficiently for insertion. The organ is then seized in the jaws of the extractor and removed slowly with a twisting motion in order to sever it from the vas deferens.

If the second testicle is easily visible and approachable it may also be removed, but care should be taken to avoid rupturing the posterior aorta which runs between the two organs. If either this artery is damaged or the intestines pierced, the bird should be killed immediately.

If the second testicle is not easy to reach from the original incision, the rib-spreader should be carefully released, the bird turned over, and the whole operation repeated from the other side.

The caponized birds should then be removed to a separate house or crate containing soft straw and fed for two or three days on mash moistened with skim milk or buttermilk. They may then resume their normal diet until ready for market.

The writer commends the process of caponization to the veterinary authorities of India, and would suggest that it be practised in all veterinary hospitals, encouraging villagers to bring their unwanted cockerels for caponization, and training suitable men to practise the operation as a trade.

SELECTED ARTICLES

PAMPAS GRASS (*CORTADERIA SELLOANA* (SCHULT) ASCHERS AND GRABEN)—A NEW SUPPLEMENTARY FODDER FOR RUMINANTS IN NEW ZEALAND

BY

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INTRODUCTION

ALTHOUGH the South American pampas grass has become established in many parts of the world as an ornamental plant, the possibility that this quick-growing giant tussock may provide valuable fodder does not seem to have been considered until quite recently, when a New Zealand farmer[1] observed that dairy cattle thrive if allowed to graze this coarse fodder as a winter supplement. The Hauraki Plains district, where the experiments were initiated, comprises the reclaimed estuarial land of the flood plains of the Piako and Waihou rivers, Hauraki Gulf, Auckland. Here the use of pampas grass as a mid-winter and mid-summer supplement has become firmly established with the result that the possible utility of this new fodder is being investigated in other parts of the North Island of New Zealand.

In the Hauraki Plains pampas grass does not naturally regenerate from seed, probably because both sexes are not represented, all stocks being asexually derived from the handsomer female plants. The extensive reclamation of estuarial lands in the Whangarei Harbour, North Auckland, has, however, become in places a nursery of wild pampas seedlings capable of supplying millions of young plants and seeds at a very low cost to farmers.

Pampas grass (*Cortaderia selloana*[2]) is the well-known South American plume grass, which, according to Lindley and Moore [I], was introduced into Europe

[1] Mr. McClean obtained with what is described by breeders as 'a very ordinary herd', a premium of ½*d*. per lb. for his produce, which was graded 'First Finest Quality' and in yield per acre exceeded that of his neighbours.

[2] The authors are indebted to the Director of Kew Gardens, Sir Arthur Hill, for the correct botanical name of this species.

in 1843 through seeds from Buenos Aires sent to the Glasnevin Botanical Gardens, Ireland. It is now thoroughly domiciled in Europe and found in almost every large garden in Britain. Hitherto, in Europe and Australia, it has been cultivated entirely for the ornamental effect of the tall, dense, silvery plumes of the female plants ; the male plants bear plumes significantly less ornamental, as shown by the two groups of wild plants in the illustration (Plate XVII, fig. 1).

PALATABILITY OF PAMPAS TO CATTLE AND SHEEP

It is stated on good authority that pampas grass in South America is regarded as a pest, and is rooted out and burnt wherever it is desired to utilize land for stock-farming ; and that it is never eaten by stock in Argentina. Because a plant is little valued in its original habitat is no proof that it will not have a use in another climate and soil, for instance, *Pinus radiata* (*insignis*) (Monterey pine) and *Cupressus macrocarpa* (Monterey cypress) were not regarded as of much economic use in California, yet when grown in South Africa, Australia, and New Zealand these species provide quick-growing timber and are valued shelter-belts and fences.

Von Mueller [2], an eminent Australian botanist, refers to the pampas grass of Uruguay, Paraguay, and La Plata as an industrial plant because, as was shown by him, paper can be made from its leaves. The Australian soil and climate, like that of South America, may be generally too dry for the completely successful use of pampas grass as a fodder, but W. L. Mardon of Sylvania, Sydney, N. S. W., a farmer of beef cattle, writes that he has always noticed that stock were fond of pampas grass at certain periods. He finds that on fair-quality drained swamp, on fair-quality black, red, or grey soils (on sandstone strata) pampas flourishes like a weed. He states that the sustaining powers of pampas grass are equal, if not superior, to those of most other herbage, and it is beyond dispute that stock relish it and graze it greedily, maintaining virile health.

Over sixty years ago experiments made with pampas grass in the moist North Island of New Zealand by Sir George Grey at Kawau Island, and by Dr. S. M. Curl [3] in the Manawatu district, suggested to them that this course grass had been neglected as a fodder plant. Dr. Curl, as early as 1876, recorded that pampas grows to a height of 10 ft., but if within the reach of stock it is kept low, for cattle are particularly fond of its rather coarse leaves, which contain a large amount of nutriment, and grow through both winter and summer, cold having little effect. As young leaves appear, all cattle and sheep will greedily eat them, leaving more delicate herbage.

In New Zealand pampas grass has been long regarded as a suitable shelter-belt plant, particularly in Taranaki, where some form of protection from the ocean winds blowing into the Taranaki Bight is essential in order to obtain the best results from farm stock, especially pigs.

As an ornamental garden plant, pampas was evidently introduced very early into New Zealand, presumably as seed, because in the days of sailing ships plants

Fig. 1. Pampas grass in flower showing male (right) and female (left) flowers at Whangarei Harbour reclamation

Fig. 2. Pampas hedge 5 years old. Dargaville. Northern Wairoa

Fig. 3. Pampas break. McClean's Hauraki Plains, showing eaten out break of pampas and mounds of dead leaves uneaten, also shallow water table

FIG. 1. Pampas plantation in flower and ready to be grazed off for the first time, Taupiri

FIG. 2. An acre of pampas in bloom, Taupiri

FIG. 3. Wild seedling pampas on reclaimed salt mud flat, Whangarei

did not travel well, and both sexes are now widely distributed. In some localities these occur together, and the seedlings spread in waste spaces. There is no record of pampas spreading into well-grazed pasture, since stock will eat out and kill any stray plants. The seed is very small: some gathered from Whangarei averaging 1,800,000 seeds to the pound. It is firmly enclosed by the glumes, so that severe treatment is required to set it free. Commercial 'seed' is therefore bulky and 'fluffy'.[1]

Pampas is to be seen growing as an ornamental plant or as a shelter-herdge in gardens and along the fences of paddocks in practically every part of New Zealand. Nearly everywhere the plants are all female, having been derived from the subdivision of a single plant, the female plant being preferred on account of its larger and more handsome plumes. In some localities (*e.g.*, in parts of Otago and Southland), however, the male plants only are to be seen.

On the stop-banks of the harbour-reclamation works at Whangarei, where stock are practically excluded, thousands of seedling pampas in all stages of growth are to be found. Several counts of areas of flowering seedlings chosen at random in this locality showed an approximately equal number of male and female plants. Some variation occurs, notably in the colour of the panicles, which in some plants is red and in others yellow. By selection from these seedlings different varieties could doubtless be produced, but such variation cannot be expected among plants asexually propagated, as by means of root-cuttings.

Farmers have observed from time to time that cattle grazed with avidity these pampas windbreaks in various North Island stations, but this observation was not followed up and merely resulted in the strengthening of the fences guarding the pampas plantations. Where the pampas can attain sufficient size before being grazed by cattle, there is evidence that fencing is unnecessary, the canes being so thickly disposed and the plants so high (up to 12 ft.) that cattle merely eat the external leaves [4] (Plate XVII, fig. 2).

Despite these numerous observations of cattle grazing pampas grass, the first recorded instance of systematic utilization of this new forage, so far as the authors are aware, is due to Mr. Alec McClean, a farmer who had recently settled on reclaimed salt-marsh land at Waitakaruru, Hauraki Plains, Auckland. This pioneer, noting that comparative analytical data for New Zealand plume grass or toe toe (*Arundo conspicua*) and pampas grass had been published [5] reported to one of us (B. C. A.) in July 1932 that for several years he had been using young pampas grass successfully as a winter fooder for cattle. He had gradually increased his plantations of pampas by subdividing the clumps and planting 6 ft. apart, *i.e.*,

[1] It is possible to clean seed by vigorous centrifuging, so detaching the seed from the surrounding chaffy scales (the glume and palea), but there is evidence that the viability of such cleaned seed decreases rapidly.

approximately a thousand plants to the acre. At the time of writing he had 9 acres under pampas for grazing, and was wintering his herd for the second year on pampas grass as a supplementary fodder. No other supplementary fodder was used, but the stock had a run-off of 48 acres on good cattle pasture. McClean claimed that with the aid of pampas grass he could carry on his farm of 200 acres (including 30-40 acres in the rough state) 200 head of cattle the whole year round. The practice in the district is to use hay as a winter supplement, but McClean found that his stock refused to eat hay when they could get pampas, therefore he abandoned hay-making and now relies wholly on pampas as a supplement. With this mild climate (mean temperature 57°, Lat. 37·25 S., rainfall 45 in., well distributed) and rich soil[1] derived from organic matter and sea-mud, the growth of pasture is practically continuous throughout the year. The illustration (Plate XVII, fig. 3) shows that the water-table is remarkably near the surface. The result of feeding the cattle on pampas was to improve their condition, and to make the health of the whole herd remarkably good. McClean assured inquirers that the yield of butter-fat was increased as soon as the herd was put on to pampas, and at once diminished if taken off that supplement. This experience was repeated in other years. His method of feeding is to allow the cattle to graze the pampas in breaks, in winter, with the aid of a movable fence, a method the cattle themselves prefer to having it cut and carted to them. Mr. McClean has modified the original method and now feeds the pampas grass to his herd twice a year instead of once, namely at the two low grass-production periods, mid-winter and mid-summer, so that pampas grass may become a supplementary fooder available at any time of year. This is particularly valuable quality for a forage plant in this country of variable seasons. Experiments, including weighing the crop, suggest that if two cuts are made a year as much as 50 tons per acre of green matter may be grown at Hauraki Plains.

The publication in October 1932 of an account of McClean's experiments [4] aroused great interest in the Waikato and adjacent districts, and the discoverer was asked both for information and plants for experimental plantations. These plants were supplied at 30s. per 100 subdivisions of the clump, a subdivision consisting of a portion of the stem (preferably one that has not borne flowers) and root. Thus an acre requiring 1,000 plants would cost £15 for plants alone. The senior author (B. C. A.) remembering that he had seen pampas growing wild and regenerating well in the Whangarei estuary (Plate XVIII, fig. 3) arranged with the Secretary and Engineer of the Harbour Board, Mr. W. M. Fraser, to utilize unemployed labour to collect seedling pampas plants for sale to farmers. This work, supervised by a skilled nurseryman, has proved very successful in establishing pampas plantations, which by this method are of better quality and much cheaper and easier to establish than by root-subdivision from other clumps, and the mortality of the seedlings is lower than that of root-subdivisions, which suffer great losses in droughts to which

[1] See analyses of soil at end.

seedlings of the right size are highly resistant. The seedlings are baled and carefully packed for transport by railway or boat at 30s. per 1,000 and already about 100,000 plants have been distributed by this method.

Although pampas was an admitted success at Hauraki Plains, where both soil conditions and climate are excellent for crop production, it does not follow that the same success will occur in other places where conditions are less favourable. The present year's work suggests that every pampas plant is palatable to cattle if the leaf is not too old . that the plant grows readily on all soils, if sufficiently deep and moist for the roots to obtain the large amount of water required for such a quick growing, tall graminaceous plant. It apparently flourishes in all climates throughout the Dominion, and has even been reported growing well in the arid district of inland Otago (Kurow) with a rainfall of 20 in. and a severely cold winter with much frost.

Other farmers' experiments and experience

The grazing experiments made in 1935 prove that pampas grass will grow successfully from subdivisions on a poor pumice soil with a deep pumice subsoil (in the Rotorua district), and that under these conditions it is attractive to well-fed calves. It has also proved attractive to stock on a poor, drained bog-land containing many stumps (Ruakuhia Swamp, near Hamilton), where no other supplementary fodder-plant could be grown.

Mr. George Short, of Dargaville, although he has never grown pampas grass for fodder alone, has used it as a dual-purpose plant—shelter and winter stock-feed—for the past 22 years in various Auckland stations, first at Aka Aka, Waiuku and latterly in North Wairoa district. All stock are fond of it and will break down good fences to obtain it. He has grown it on drain-banks, in paddocks, and on 'poor gum-land hills', where it thrives. It would be a great asset on exposed farms near the coast, where other shelter does not thrive. Mr. Short's photos of pampas-grass hedges five years old show how it is possible to utilize these hedges without fencing for both shelter and stock-food, if the pampas grass is allowed to grow for a few years until too dense to be eaten out entirely (Plate XVII, fig. 2).

Mr. R. G. Cranwell, of Tuikaramea Road, Frankton Junction, planted ¾ acre with pampas cuttings in the Ruakuhia Swamp, in which no other supplementary fodder could be grown, owing to the submerged stumps and other subsoil conditions. These were grazed off in the winter of 1935. The cattle ate the pampas greedily, and afterwards, when excluded from the plantation, endeavoured to get in again.

Mr. F. R. Seddon, Puketaha, seven miles from Hamilton, on the deep part of the Eureka Swamp, had planted four acres fenced into three strips. Two of these were grazed down last winter (1935), the middle strip being left. The results were satisfactory and are interesting as showing that, when grazed in winter, plants

grow again so quickly that by the following autumn their leaf-growth nearly catches up that of young established ungrazed plants which were planted at the same time; the ungrazed plants developing flower-heads which reduces the development of leaf (Plate XVII, fig. 4).

The Ruakura Farm of Instruction, Hamilton, established several plots of pampas plants, derived from different sources. The plot from root-cuttings showed a high mortality, but the plants grown from Whangarei seedlings had practically all 'taken' and showed quite as much leaf-growth as the surviving plants from the cuttings, and, in addition, a far greater amount of stooling throughout the seedling plot. Mr. Rodda, the Manager, was quite convinced that the seedling method was the better way of establishing a plantation.

Mr. Grahame J. W. Harvey, Taupiri, has planted three acres from root-cuttings which will be fed off this winter (1936). This dairy farmer is a skilled plant-propagator, and as he is experimenting with Hauraki cuttings, Whangarei seedlings, and seedlings derived from English purchased seed, valuable results can be expected from his farm (Plate XVIII, fig. 1).

Mr. Joe B. Simpson, from long farming experience in Taranaki, states that pampas grass (1) gives good shelter for young tethered calves, (2) provides ideal thatch, (3) is a good rough winter-food, (4) is easy to grow and provides an enormous amount of food, and (5) will improve rough parts of the farm and check growth of noxious weeds.

Major R. A. Wilson informs the authors that on his Himatangi (Foxton) sand-dune property wild pampas grass is eaten down every winter by cattle. The use of pampas grass as a new plant-staple for fixed dunes opens up fresh possibilities for farmers on the dunes. Himatangi appears to be the most southern locality where pampas grass is regenerating naturally.

Four or five of the leading types of soil in the Auckland province have, therefore, been proved to be successful sites for pampas plantations; one of them extremely rich in plant-food, the others extremely poor; the climates being fairly uniform but the soils differing in texture and composition, only one feature being common to all, *viz.*, the good water-supply in the soil available for deep-rooted plants.

Estuarial reclamations would seem to be particularly suitable for pampas plantations, but these differ in mineral plant-food content; Whangarei drained salt marsh being extremely poor and Hauraki estuaries very rich, yet pampas grass flourishes equally in both and is palatable to stock in both; indeed, in some areas at Whangarei the pampas subjected to uncontrolled continuous grazing by cattle has been eaten out and destroyed.

There seems, therefore, to be every prospect of this new fodder-plant becoming a permanent feature of North Island dairy farms, where the soil and subsoil, being fairly deep, allow free descent of pampas roots to the moister subsoil. In

the Hauraki Plains the roots have been traced to a depth of 8 ft. The Auckland province is well supplied with water, the annual rainfall on the low levels being generally from 50 to 60 in., falling on 150 to 175 days, whereas in the Hawkes Bay province, the driest area in the North Island, the rainfall is only 35 to 45 in., falling on 125 to 155 days. This area suffers from occasional droughts. It will be interesting to compare the growth of pampas in Hawkes Bay with that on the mositer soil of the Auckland provincial district. A number of Hawkes Bay farmers obtained pampas plants from the Hauraki Plains district by subdivision of clumps. Unfortunately, these were planted just before the droughty summer of 1934-35, with the result that almost all of them failed. A similar result attended the trials of an experienced farmer in the Manawatu district under droughty conditions. It is probable that, had seedlings been used instead of subdivisions, the experience would have been much more favourable, as seedling-plants in the Wellington City district, which suffered from the same drought, experienced no mortality.

Although young pampas plants or cuttings are peculiarly susceptible to drought, when once established this new fodder-plant is drought-resistant—another valuable character. In the very dry summer of 1934-5 production of butter-fat in the Hauraki Plains received a severe check ; many farm herds yielded only half the usual quantity, and farmers were hard pressed to provide sufficient feed for the cows. Ensilage, saved for the winter, and turnip crops, although only half-grown, were fed on most farms. In spite of the shortage of pasture Mr. McClean enjoyed almost a record season, and the butter-fat production dropped only a few points below his normal average for January. This happy position he attributed solely to the pampas grass which he fed regularly, and of which he had sufficient reserve for winter food. The pampas did not appear to suffer in growth or succulence from the drought.

P. W. Smallfield, Fields Superintendent, Department of Agriculture, Auckland, writes recently : 'I visited Mr. A. McClean's farm at Waitakaruru, and watched the dairy herd grazing off a break of pampas grass. Mr. McClean has for a number of years been experimenting with pampas grass as a supplementary stock-food, and recently the usefulness of this plant for general feeding has received wide attention. Some quite useful plantations have already been established on some of the poor peat areas of the Waikato, and there is no doubt that the plant has possibilities. No one could watch the cows on Mr. McClean's farm quietly grazing the pampas plants without being impressed with their potentialities—an actual living fodder for winter feeding.'

That pampas will flourish in the driest Hawkes Bay district, if the requisite cultural conditions and proper method of obtaining the plants are used, is proved by the experience of a farmer at Waipawa, Mr. J. J. Carter, who had exceptionally good results in establishing a batch of seedlings, which, unfortunately, arrived in a very dry state from Whangarei in October. He had, however, the good fortune to plant them in a year which was exceptionally wet, and on well-tilled and

between rows of Chou moulier crop. Seen in December 1935 (mid-summer in New Zealand) by the junior author (R. E. R. G.) the majority of the plants showed signs of growth mostly confined to a single leaf appearing from one shoot. Seen again in mid-April 1936 the pampas had made splendid progress, individual plants being 4-6 ft. high and each having more than a dozen shoots. The growth made here was better than any observed in the milder Waikato district, except possibly in one instance. Some seedlings which were apparently quite dead when received, but had been given special treatment in a garden, responded to the better soil conditions of the garden and much surpassed those grown in the field, showing in April growth over 6 ft. long, some having stooled to about 12 in. across, and having a score or more shoots.

This farmer is convinced that, provided seedlings are planted out when received in the place that they are to occupy permanently, which should be well prepared beforehand, seedling pampas responds exceptionally well to good tillage, water-supply, and weeding. He also considers that the plants must be well fenced from stock, as when some sheep were put into the Chou moulier, a splendid crop, they broke into the pampas and ate some plants, neglecting the associated growth of clover, grass, and weeds.

This farmer's experience of the phenomenal growth of seedling pampas has been borne out by the senior author in his garden in Karori, Wellington, 200 miles south of Hawkes Bay and 600 ft. above sea-level, on a windy hill-side but the ground had been well trenched. Twenty seedlings from Whangarei were planted closely in a line, and when a year old the first cut had to be made because the plants were shading other vegetable crops adjacent. The first cut was made on December 24, 1935, the weight being 25 lb., and the second cut was made on March 11, 1936, the weight being 23 lb.—a total of 48 lb., green weight, for the 20 seedlings. By April 12, 1936, the plants had grown another 15 in. high. Pampas evidently benefits greatly by planting in deeply tilled soil even though air and soil temperatures are low.

Chemical investigation

In this investigation an attempt has been made to compare the composition of the pampas grass with that of certain well-known forage grasses, and to correlate, if possible, the feeding-value of this grass with the analytical data given below [7, 8]. The analyses of the pampas grass were made on samples taken from the Hauraki Plains. Sample No. 1 was representative of plants that had been fired six to seven months before cutting ; sample No. 2 comprised the growth from two plants (110 lb.) during a period of about one year. A detailed account of the chemistry of the carbohydrates of these grasses is not of immediate interest and will be published elsewhere.

Although much information on the mineral-content and composition of the fats and proteins in the various forage grasses is available, the systematic

treatment of cell-wall constituents, or structural carbohydrates, and the sugars has been practically neglected.

In Table I the chemical composition of pampas grass is compared with that of well-known forage grasses. Special attention has been given to the structural carbohydrates which, besides constituting the bulk of the dry matter in a grass, serve to discriminate between the various species.

It has been customary to group the cell-wall constituents under the term 'crude fibre' and to attribute to this fraction an energy value in the nutrition of ruminants equivalent to that of an equal weight of starch, on the ground that it is broken down in the rumen by bacteria into readily assimilable glucose. Such empirical treatment of the food-value of crude fibre, consisting as it does of a heterogeneous mixture of cellulose, hemicellulose (pentosans, hexosans), and encrusting materials, such as lignin, has not met with complete approval. It is likely, for instance, that the constituents of the crude fibre vary individually in their availability to the animal. The experiments of Furth and Engel (1931), and of Stone and Jones (1892), quoted by Mangold [11], show that the hemicelluloses, like the cellulose, are readily digested by ruminants. In contrast with starch, however, these two constituents are both made available, not by enzymic action, but by bacteria in the rumen ([12] and Schieblich, 1932, quoted in [11]). It is generally accepted that lignin is either not readily available or completely indigestible [11], but according to Woodman and Stewart [13] the digestibility of cellulose is not entirely dependent on the degree of lignification or the lignin-content of the crude fibre, since, for instance, in grass the decrease in digestibility, with age is associated with a relatively small increase in lignin-content. The crude fibre constitutes the essential material of the cell-membranes, and the contents of the plant-cells can be utilized only if the cell-wall material is digestible or readily ruptured. It is apparent, therefore, that from the nutritional point of view alone further systematic examination of the cell-wall carbohydrates is needed.

Regarding the structural carbohydrates Table I shows that the chief difference between the pampas grass and the common forage grasses lies in the higher percentage of cellulose (37-41 per cent as compared with 21-33 per cent). This relatively high percentage of cellulose, together with the large yield of green material (estimated at 50 tons per acre [4]), suggests its use for paper-manufacture. The esparto grass of Spain and Algeria, used for paper-pulp, contains about 45 per cent of cellulose. Comparative figures for the lignin in the common forage grasses are not available. The determinations of this substance in the pampas grass gave from 16·5 to 18·5 per cent, as compared with 17·9 per cent given by Norman and Jenkins 14 for grass. Less sugar appears to be present in the pampas than in the other grasses given in the table. As compared with the standards given by Orr [15] for good forage grass, the pampas grass, including the whole of the above-ground portion, or considering the green leaf and basal portions separately, is

TABLE I

The composition of grasses[1]

Species	Ash	Reducing substances (as glucose)	Reducing substances after hydrolysis (as glucose)	Total pectin (as Ca pectate)	Total hemi-cellu-lose	Cross and Bevan cellulose	Lime (CaO)	Phos-phorus pentoxide (P_2O_5)	Protein (N × 6·25)
Cocksfoot (*Dactylis glomerata*)	8·16	3·54	5·51	1·97	18·31	33·20	0·49	0·74	13·99
Meadow-fescue (*Festuca pratensis*).	7·93	1·25	6·25	1·60	18·47	24·07	0·60	0·48	10·63
Chewings fescue (*Festuca rubra*).	8·32	1·01	4·70	0·90	20·70	21·38	0·59	0·51	13·56
Crested dogstail (*Cynosurus cristatus*).	9·08	3·67	13·10	1·02	16·30	23·25	0·32	0·52	10·13
Pampas grass (*Cortaderia Selloana*) :—									
Sample No. 1 . .	10·55	2·62	3·69	0·86	19·15	40·33	0·47	0·44	9·87
Sample No. 2 :—									
Leaf portion . .	8·44	1·73	4·04	1·06	21·44	40·50	0·22	0·24	8·49
Basal portion . .	7·26	2·60	4·96	1·54	23·51	37·32	0·15	0·22	5·43

Italian rye-grass (*Lolium italicum*).	10·10	2·87	9·05	1·04	17·60	23·95	..	..	..
Timothy (*Phleum pratense*)	8·18	2·25	6·87	1·54	17·22	20·83	0·39	0·53	12·14

[1]With the exception of the pampas grass, the figures for ash, reducing substances, pectin, hemicellulose, and cellulose were taken from Buston [9]; for lime, phosphate, and protein, from the unpublished work of Shorland and McIntosh on the experimental plots of the Department of Agriculture at Kaharoa. All the results are expressed as a percentage of the material dried at 100°C.

Note by R. F. McIlroy:—For comparison with grasses analysed by Buston [9] the total hemicellulose in pampas grass samples 1 and 2 was estimated by his micro-method, which involves treatment of the grass with 50 per cent alcohol containing 1 per cent sodium hydroxide to remove 'ligno-saccharide' prior to extracting the hemicellulose with 4 per cent sodium hydroxide.

Recently Norman [10] has shown that this pre-treatment removes hemicellulose as well as lignin. Accordingly, the previous treatment was omitted, the crude hemicellulose obtained being corrected for lignin, estimated by hydrolysis with 72 per cent sulphuric acid. By this method sample 1 yielded 24·43 per cent total hemicellulose in the dry material.

Crude hemicellulose . . . . 27·13 per cent
Lignin in hemicellulose . . . . 2·70 per cent

Therefore total hemicellulose . . 24·43 per cent
(mean of three determinations)

Loss in alcoholic-alkali treatment 24·43—19·15=5·28 per cent

deficient in lime, phosphate, and protein (CaO, 0·15—0·47 per cent, as compared with 1·10 per cent ; P_2O_5, 0·22—0·44 per cent, as compared with 0·77 per cent ; and protein, 5·43—10·67 per cent, as compared with 18·3 per cent.). When, however, it is considered that pampas grass is intended only as a supplementary fodder, it will be appreciated that the high proportion of carbohydrates is useful in balancing pastures high in protein, whilst the evident palatability and high yield of dry matter (more than 25 per cent) must not be overlooked. Turnips, for example, although richer in protein (14·4 per cent), are poor in phosphate (0·14 per cent P_2O_5), and contain only about 10 per cent of dry matter, whilst hay from mixed grasses contains 8·75 per cent protein and 0·38 per cent P_2O_5 [16].

To account for the evident ease with which such a fibrous plant as pampas grass is digested by ruminants, it has been suggested that as lignin occurs in intimate associating with cellulose, these constituting together the greater part of the fibre or cell-wall, the lignin, being itself indigestible, protects the other plant constituents against the action of the ruminant's digestive juices. Where, however, as in pampas, the same amount of lignin is spread over a much larger amount of cellulose, the protective action of the lignin will be diminished and the plant more easily digested.

Summary

Pampas grass (*Cortaderia Selloana*) provides under certain conditions an excellent supplementary fodder for cattle, the coarse leaves being easily grazed. The New Zealand pulme grass or toe toe (*Arundo conspicua*), although similar in appearance to pampas grass, is not readily eaten by stock, unless chaffed, on account of the relatively great tensile strength of the leaves.

Pampas grass flourishes on a wide range of soils in New Zealand, being particularly suitable for reclaimed salt marsh. Although plantations suitable for grazing may be established from cuttings, the ideal method is to plant from seedlings which are spaced 6 ft. apart (1,000 plants per acre). The seedlings, at first in seed-pans, are transferred after selection to a frame or a suitable seed-bed. When they are 6 months old they are ready to plant in the field. The planting should be done in the spring when there is no longer any danger of frost. The plantation should not be grazed until the end of the second year and then only intermittently in breaks, the animals having a run of pasture.

Comparative analytical data show pampas grass to be low in phosphate, lime, and protein, as compared with the common forage grasses. The high proportion of carbohydrate, however, is useful in balancing the high protein-content of young pasture grass.

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Analyses of soil at Waitakaruru, Hauraki Plains, Auckland (*cf. page 365-366*)

(*a*) *Mechanical analyses*

Results are percentages on air-dried soil.

Soil	Analysis of " Fine Earth " passing 2-mm. sieve									Stones and gravel.	
	Fine gravel	Coarse land	Fine sand	Silt	Fine silt	Clay	Moisture and loss on ignition		Loss by solution		
Loam . .	7·9	17·5	1·3	7 8	18·3	12·7	2·9	33·1	1·5	2·5*	Top
Clay . .	0·5	1·9	1·0	8·5	34·5	89·2	2·6	12·5	1·3	tr.*	Sub

(*b*) *Chemical analyses*

Results, except*, are percentages on soil dried at 100°C.

Locality	Volatile matter			Total nitrogen	1 per cent citric-acid extract, Dyer's method., Hall's modification ('Available plant food')			
	*On air-drying	*At 100°C.	On ignition		Lime CaO	Magnesia MgO	Potash K_2O	Phosphoric acid P_2O_5
Top. McClean, Waitakaruru, unmanured. Peaty .	31·0	2·9	34·2	0·808	0·063	0·127	0·018	0·04
Sub. ———	32·9	2·6	12·9	0·275	0·054	0·154	0·025	0·09

Locality	Hydrochloric-acid extract ('Total plant food')				Lime-requirement % $CaCO_3$		pH
	Lime CaO	Magnesia MgO	Potash K_2O	Phosphoric acid P_2O_5	On air-dried soil	On soil dried at 100°C.	
Top. McClean, Waitakaruru, unmanured. Peaty . . .	0·20	0·54	0·36	0·23	1·10	1·13	4·8
Sub. ———	0·27	1·12	0·51	0·26	0·51	0·52	5·0

* Pumice and organic matter.

MODERN CULLING OF LAYING HENS

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THE operation of culling or the sorting of the good from the bad amongst hens bred for egg production should be carried on all the year round.

Eggs.—Preliminary elimination of unprofitable birds commences in discarding unsuitable eggs for incubation. This operation is most important as it goes to the root of the existence of culls. For this reason there are some men devoting all their time and energies to the production of better stock; they are the stud breeders.

The commercial egg-farmer, therefore, will have this selection done for him if he purchases his stock from a reliable stud breeder, which practice is strongly recommended. If stock is not purchased annually in the form of day-old chickens then the commercial egg-farmer must go to considerable trouble and expense in selecting his breeding birds. The hens must be true to type and, more important from his point of view, have a record of at least 200 eggs in their pullet year of good standard size (2 oz.) quality, texture and shape. The male birds must, if possible, be even of better lineage than the hens from a production point of view and of robust vigour. As stated previously, the eggs from these selected pens must then be culled before incubation. Select only 2-2 1/4 oz. eggs of correct shape, good smooth texture and the correct colour, for the breed, *e.g.*, all Leghorn eggs must be chalk white. Eggs for incubation should not be more than 7 days old in order to hatch sound, robust chickens artificially.

Chickens.—On hatching, culling commences immediately by refraining from assisting weak chickens from the shell; these will only be culled in a few months time after they have cost a few shillings more, so don't throw good money after bad.

Any deformed or weakling chickens should be killed when the hatch is taken off. Thereafter, during the whole growing period, any chickens not growing out well should be examined, and if the cause can only be laid at the door of poor constitutional ability then they should be disposed of to the best advantage, which may mean simply killing them off.

Pullets.—With the commencement of lay of the pullets the work of culling on actual production begins. The previous work done till now simply ensures that every pullet coming to maturity has the best chance the owner can give it of proving itself profitable.

Precocity.—Experiments [1] have shown that the best laying birds mature early and that the birds putting on the worst records usually commence to lay late in their pullet year. Therefore, the age of maturity, that is when the pullet comes into lay, is of great importance and helps in good culling practice. The quickness of feathering over the back is a guide to the precocity of pullets. Environment and management have a good deal to do with this rate of maturity, but even so the best birds will invariably mature first.

All pullets of the Mediterranean class should commence to lay in 200 days from hatching, and pullets of the dual-purpose class—most English and American breeds—should commence in 260 days if the rearing management has been on correct lines. Pullets taking longer than this to mature are usually more profitable if sold before they have eaten any more feed. On the other hand very precocious pullets are abnormal or badly managed and will more often than not be lacking in constitution and lay small eggs, so should be culled in most cases.

At this point culling practice may be continued by either (1) trapnesting or (2) individual examination of external characteristics.

(1) *Trapnesting.*—This method of determining the actual record of a bird was first made use of, as far as we know, by the late Douglas Tancred in the United States of America.

The chief use of trapnesting is the selection of the best birds for pedigree breeding work, but to obtain the fullest use of them they should also be used on this type of poultry farm for culling the non-productive pullets. Any pullets not laying an average of 12 to 15 eggs during the first three months of laying will probably fail to score 150 eggs for the year, a number which is to-day reckoned the low limit for profit on the poultry farm where birds are fed on purchased feeds in semi-confinement. It will pay best to cull these pullets at the end of three months trapping, also any persistently laying abnormal eggs of any description. During the remainder of the year all birds that show signs of failing to reach the 150 egg standard for any reason should be sold off.

At the end of the year only birds having laid 150 marketable eggs or over should be kept for the following laying season.

This system is, of course, excellent, providing a true record and enabling the owner to dispose of his culls the moment they become unprofitable and spreading the sales throughout the year. It is excellent for the poultry man near a good market where he can dispose of several dressed culls per week, for he will realise

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[1] Rice (1915), Goodale (1918), Kennard (1921), Hays and Bennett (1923), Buster (1924), Jull (1924), Kempster (1925).

much more for them in this way than by selling a large number all at once as live birds. It is, however, a somewhat expensive system compared to the second method. (For construction of trapnests see Bulletins 870 and 875, obtainable from the Department of Agriculture, Salisbury).

(2) The method of culling by means of the examination of the external characteristics of the hen was first used by the late Walter Hogan in the United States of America in 1905. The system is much the same to-day and is often still called "Hoganising."

In later years experiments have shown the correlation between the different physical characters and annual egg production; some have been found to have no correlation however. The characters chiefly held worth while studying to-day are :—

1. Pigmentation in yellow-skinned breeds.
2. Time of annual moult.
3. Capacity of abdomen.
4. Pliability of abdomen.
5. Width between pubic or pelvic bones.
6. Comb texture.

It will be noted that these are all physiological characters. The body measurements or morphological characters have shown less correlation with annual egg-production and, therefore, less emphasis should be placed upon them when using this method of culling.

(1) *Pigmentation.*—The yellow-skinned breeds possess a yellow pigmentation beneath the skin which is probably the most reliable single character for judging the production of a hen.

Palmer (1915) has shown that the presence or absence of this pigment in the fowl or its eggs is directly correlated with the presence or absence in the feed of a carotinoid pigment called xanthophyl. It is clear, therefore, that hens fed on a ration of feeds devoid of this pigment may be pale and have the appearance of having laid, though actually they may not have produced an egg. The character of the feed being fed, therefore, should be considered when culling by pigmentation. Feeds such as yellow maize and all green feeds are rich in this yellow pigment. When a pullet commences to lay this pigment from the feed passes directly to the ovary and the developing yolk. Gradually the pigment stored in the body is drawn upon as production continues and does not return until the bird ceases to lay.—Blakeslee and Warner (1915), Palmer and Kempster (1919). The pigment disappears from the body in the following order as laying progresses :—

1. The vent loses its pigment rapidly so that a white or pink vent indicates laying and a yellow vent that the bird has ceased to produce.

2. The eyering formed by the inner edges of the eyelids loses pigmentation a little more slowly than the vent.
3. The earlobe is the next to bleach out, by which time the bird will have been in production for 2-3 weeks.
4. The beak loses its pigmentation from the base first and the point last. The lower beak bleaches more rapidly than the upper one. A completely bleached beak indicates 4-6 weeks continuous production.
5. The shanks are the last to bleach because of slow circulation, commencing from the front and ending last of all at the back at the base of the hock. A bleached shank indicates continued production for about five months.

When a hen ceases to lay the pigment returns to the body in the same order in which it left. With a little thought, therefore, it is possible to tell fairly accurately the history of the last six months production of any yellow-skinned bird normally fed. For instance, pale shanks, yellow beak, yellow vent will indicate that the bird laid more or less continuously for five months, but has ceased to lay for about one month. Pale shanks, pale vent, pale tip to beak with a yellow band around the beak, will indicate five months production, a break of non-productiveness or short duration occurring 2-3 weeks ago, whilst the bird is now in production again.

(2) Time of annual moult is the next to be considered when the main culling is done at the end of the first laying year when the bird has been in production for twelve months. In this respect due regard must be paid to the time of hatching, as it is found that late hatched pullets moult later than early hatched pullets. With this in mind, however, it has been shown that pullets moulting late in the season are better producers than pullets moulting early in the season. To make this clearer, a pullet hatched in July, if she moults in November the following year, will be a lower egg-producer than a pullet hatched at the same time that does not moult until the following March, provided always that outside influences are not concerned. Further, an early moulter usually takes longer to renew her feathers than the late moulter who moults quickly and is often in production again before the early moulter, thus she is out of production for a much shorter period. Blakeslee, Harris, Warner and Kirkpatrick (1917), Van Rooyen (1932).

(3) Capacity as indicated by the distance from the tip of one pubic bone to the posterior point of the keel is an indication of annual egg-production. Normally the greater the distance the better the egg-production. Van Rooyen (1932).

(4) Pliability of abdomen is judged by feeling the skin of the abdomen between the fingers. The heavy producer has been shown to have a velvety skin and the whole abdomen soft and pliable, whereas the low producer has a thick, hard skin usually with a layer of hard fact beneath.—Van Rooyen (1932).

(5) Width between pubic bones in the good layer is great whilst in the poor layer the bones may be almost touching. This measurement and also that of capacity varies according to whether the bird being handled is actually in lay at the time or not, and due consideration must be allowed for this. The pubic bones themselves in the heavy layer are thin and tapering and pliable, whereas in the poor producer they are thick, blunt and stiff.—Sherwood (1922), Van Rooyen (1932).

(6) Comb texture is gauged by the smoothness or otherwise of the surfaces of the comb. The high producer when in lay has a large full smooth waxy comb and wattles, whereas the poor producer's head appendages are smaller, rougher and coarser.—Blakeslee, Harris, Warner and Kirkpatrik (1917), Van Booyen (1932).

The correlation between these six characters and annual egg-production has been shown by investigators, but there are other minor characters which undoubtedly are also correlated in this way and are always found in the good producer —they may be summarised as follows :—

A bright prominent round eye ; freedom of feathering round the face ; tightness of feathering ; the face clean cut and rather thin ; strong well arched beak ; the temperament is active, nervous and alert, yet the bird is friendly and easily handled, especially if trapnested ; appetite seldom satisfied. A broad back and deep body are also desirable, though not esssntial, for the great layer.

General activity and vigour, of course, play a great part in the make up of the high producer. It must be clearly understood that when handling birds for culling using these principles due regard must be paid to age and breed of birds. Also, it is essential that the operator should take into consideration all the characters as set forth and not cull a bird for failing in one or two respects. Judgment is required. Practice is essential before anyone can become really efficient, though it comes very easily. It is the duty of every poultryman to understand this work to the best of his ability, for to obtain the best results from his flock he must perform the operation himself when production indicates. He knows best how the birds have been managed and, therefore, is in the best position to cull them.

This main culling by means of examination of the external characters as enumerated should be carried out in mid-December in order to get as many birds sold during the time when high prices are ruling and when early moulters have stopped laying. A later culling may take place in February or March, when the best birds are being selected for breeding purposes.

The best method of handling the birds is to drive them, a few at a time, from the laying house through a trap door into a catching crate. From the crate they are culled and placed in their respective pens. By this means the birds are not frightened and the operator can be working the whole time. A catching crate has sliding doors at each end and a hinged door on top for the removal of birds.

To cull, a right-handed person should grasp a bird in the crate by a wing close to the body, remove it carefully and then grasp the legs immediately above the hocks in the left hand between thumb and fingers, having the head towards the operator and the breast of the bird lying flat along the palm of the hand. In this attitude the bird may be turned in any position for examination and handled easily and correctly with the right hand.

If a flock of pullets is culled at the end of the first laying year, the remaining birds should pay to keep for the next year. At the end of the second laying season only those birds good enough to be classed as breeders should be kept for a further season, for production is highest during the first season and normally drops every succeeding year.

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ABSTRACTS

The classification of the cottons of Asia and Africa. J. B. HUTCHINSON AND R. L. M. GHOSE (*Ind. J. Agric. Sci.*, **7**, 233)

(1) THE present state of knowledge concerning the classification of *Gossypium* species is summarised with particular reference to the literature on Asiatic cottons.

(2) A classification of the indigenous and naturalised cottons of India and Africa is developed on the basis of modern genetic and taxonomic knowledge.

(3) Cultivated Asiatic cottons are classified as follows :—

G. arboreum L. var. a. *typicum*
var. b. *neglectum*
var. c. *cernuum*

G. herbaceum var. a. *typicum*
var. b. *frutescens*
var. c. *africanum*

(4) *G. arboreum* var. *typicum* and *G. arboreum* var. *neglectum* are divided on geographical grounds, and on account of their recent evolutionary history, into four forms :—

I. forma *bengalensis*
II. forma *burmanica*
III. forma *indica*
IV. forma *soudanensis*

(5) Cultivated New World cottons are classified according to Harland's scheme into :—

G. hirsutum L.
G. religiosum L.
G. barbadense L.

6) *G. Stocksii* Mast., the wild cotton of Sind and Arabia, and *G. anomalum* Wawra and Peyr., the wild cotton of Somaliland and the Sudan, are described and the parallelism between them and *G. herbaceum* L. and *G. arboreum* L. is discussed. *G. Bakeri* Watt, a little known wild species from Sind, is mentioned. Reference is made to *Cienfugosia triphylla* Engler, which is transferred by Chevalier [1933], and Skovsted [1935] to *Gossypium* as *G. triphyllum*.

(7) The distribution of the Asiatic species and recent evolutionary trends in them are discussed.

(8) The present status of the New World species in India and Africa is summarised. (*Authors' abstract*)

Studies on the root-rot disease of cotton in the Punjab, III. The effect of some physical and chemical factors on sclerotia formation. R. SAHAI VASUDEVA (*Ind. J. Agric. Sci.*, **7**, 259)

EXPERIMENTS conducted to determine the conditions for the formation of sclerotia of *Rhizoctonia bataticola* and *Rhizoctonia solani* show that the intensity of sclerotia formation depends on the concentration, depth and the *p*H value of the medium. The importance of sugar, nitrogen and phosphatic constituents on the sclerotia formation has also been explained.

The nutrient media containing ammonium salts have a toxic effect on the growth of the fungi studied.

Dilute solutions of mercuric chloride, copper sulphate and phenol are quite effective in checking the growth of *Rhizoctonia bataticola* and *Rhizoctonia solani.*

Hydrocyanic acid gas penetrates in the soil up to a depth of 18 inches and kills the resting bodies of the fungi. (*Author's abstract*)

A comparative study of species of *Septoria* occurring on wheat. J. C. LUTHRA, ABDUS SATTAR and ABDUL GHANI (*Ind. J. Agric. Sci.*, **7**, 271)

1. THE following three fungi have been studied :—
   (*a*) A *Septoria* species causing a disease of wheat in the Punjab.
   (*b*) *Septoria tritici* Desm.
   (*c*) *Septoria nodorum* Berk.

2. The symptoms of the disease and nature of injury caused by the various fungi as observed on naturally or artificially infected plants have been described.

3. A comparative study of the various fungi has been made as regards the following :—
   (*a*) Morphology on the natural host and on various artificial culture media.
   (*b*) Response to environmental conditions such as nature of medium, acidity of medium and temperature.
   (*c*) Manner of spore germination under a variety of conditions.

4. Inoculation experiments have been done on wheat and various other plants in pots as well as in field and the following results have been obtained :
   (*a*) All the three fungi are highly specialised on wheat.
   (*b*) The species of *Septoria* which occurs locally and *Septoria tritici* mainly attack leaves and leaf sheaths and rarely stem and awns and *Septoria nodorum* generally causes blotch on the glumes.

5. A discussion of the experimental results in relation to the taxonomy of these forms is given and the following conclusions are reached :—
   (*i*) *Septoria tritici* and *Septoria nodorum* are different from one another and are confirmed to be good species

(*ii*) The species of *Septoria* causing a disease of wheat in the Punjab is identical with the species *Septoria tritici*. It may however be considered a slow-growing strain of *Septoria tritici* Desm. (*Authors' abstract*)

Studies on *Schistocerca gregaria* Forsk. IX. Some observations on the histology of the blood of the Desert Locust. C. B. MATHUR and B. N. SONI (*Ind. J. Agric. Sci.*, **7**, 319)

THE haematocytes of the blood of the Desert Locust are colourless nucleated cells floating in transparent greenish plasma. In the earlier hopper stages the plasma is loaded with fatty globule and the number of haematocytes per unit volume is small. As the locust reaches advanced hopper stages the haematocytes become more numerous and the fatty globules diminish, till in the winged stage it is rarely that fat globules are present in the plasma.

There are four forms of the haematocytes, *viz.*, (*i*) mother cell, (*ii*) proleucocyte, (*iii*) granular leucocyte, and (*iv*) phagocyte. The 'mother cell' is small and circular in form. It is at this stage only that multiplication (by mitotic division) takes place. The proleucocyte arises from the 'mother cell'. The granular leucocyte and the phagocyte both arise from proleucocyte. A granular leucocyte is characterised by the presence of albuminous granules, which are hypertrophied mitochondria and unlike the latter are resistant to the action of acetic acid and alcohol. These leucocytes serve as nutrition storage cell.

A phagocyte, as the name implies, possesses phagocytic properties. It abounds in mitochondria which seem to help the cell in its phagocytic function.

The cytoplasmic inclusions, the golgi bodies and the mitochondria, are present in all the stages. In granular leucocytes, in addition to these, the mitochondria in their modified forms, namely, as albuminous granules, are also present.

There is no amitotic division, nor do the haematocytes, in any stage, possess amœboid movement. (*Authors' abstract*)

A preliminary microphotographic study of the fat globules of the milk of Indian breeds of cows and buffalos. ZAL R. KOTHAVALLA and S. D. SUNAWALA (*Ind. J. Vety. Sci. & Anim. Husb.*, **7**, 8)

THE authors have recorded the variations in the size and number of fat globules of the milk of Indian buffalo breeds and two classes of cow breeds, the draft and the milch breeds. The buffalo's milk as compared with that of cow's is shown to have fat globules of a larger size though smaller in number. Cow's milk of the draft breed is shown to have fat globules of medium and more uniform size and more in number when compared with that of milch breeds. An attempt is made in classifying the suitability of the milk of Indian breeds in producing the different dairy products like butter, cream, cheese, etc., based on the shape, size and number of fat globules. (*Authors' abstract*)

Theileriasis of cattle in India. S. K. Sen and M. K. Srinivasan (*Ind. J. Vety. Sci. & Anim. Husb.*, **7**, 15)

The acute or fatal forms of bovine theileriasis in India resolve themselves into two well-differentiated categories, as described below :—

(1) *Theileriasis in imported Friesian bulls.*—The disease usually runs a chronic course, with periods of prolonged absence of any clinical symptoms, but it may suddenly assume an acute form and rapidly progress to a fatal issue. The affected animals exhibit an elevation of body temperature and sometimes also symptoms of "pica", whilst the visible mucous membranes are often markedly anæmic, although this last may sometimes be negligible. Lachrymation and marked swelling of the superficial lymphatic glands are also fairly constant features of the disease. The examination of blood smears frequently shows only rare or few parasites and Koch's bodies, but in a proportion of cases they may occur in large numbers when the disease is at its height, the majority of the parasites being round or oval in form and nearly 50 to 70 per cent of the red blood-corpuscles being invaded by them. There is no solid or sterile immunity in this condition, but a state of premunition, and recovered animals are liable to relapse. The rate of mortality amounts to 25 to 30 per cent. The outstanding features of *post-mortem* appearances are an enlargement of the liver and spleen and the occurrence of petechiae in various organs.

The species of parasite concerned in this form of theileriasis possesses characters which are mostly identical with those described by du Toit (1930) for *Theileria annulata*, and all available evidence points to the conclusion that the infection is exotic in origin, the organisms being probably acquired by the animals during the course of their voyage to India.

(2) *Theileriasis in Indian cattle.*—This condition, which forms the main subject of the present paper, has been extensively studied in artificially infected hill bulls, the disease having been successfully reproduced in them by the inoculation of virulent blood and organ emulsions, although nearly 47 per cent of the animals proved refractory to the infection.

The average incubation period in artificial infection is 16 days, and in fatal cases the average duration of the disease is 5·5 days, but when recovery occurs, it extends over a period of 4 to 17 days. The principal symptoms consist of an elevation of the body temperature, progressive inappetence and an enlargement of the prescapular and precrural glands, whilst the visible mucous membranes show varying degrees of icterus and petechiae. In a number of cases, the temperature suddenly drops down to subnormal before death ensues, but when death occurs early, the temperature remains high. The examination of blood taken at the first rise of temperature frequently reveals the presence of rare parasites and Koch's bodies or both, but the parasites rapidly increase in number as the disease advances and may eventually invade 50 to 100 per cent of the red blood-corpuscles, although Koch's bodies may vary in number from "rare" to "numerous". The parasites are usually seen as round forms, the "rods" being rarely encountered. The rate of mortality amounts to more than 75 per cent.

The sequence of changes occurring in the blood of an affected animal has been found to furnish a fairly reliable indication as to its chances of recovery. In the event of the prognosis being good, the first noticeable change in the blood picture is the occurrence of anisocytosis, this being followed by polichromatophilia and granular basophilic degeneration.

The most constant *post-mortem* findings are a thin and watery character of the blood, oedema of the lymphatic glands and of the spleen and a gelatinized condition of the body fat. There are petechiae of the serous membranes and respiratory tract, whilst the abomasum may show characteristic ulcers.

The parasites remain viable up to 96 hours at 21°-22°C., and when stored in the refrigerator, they lose their infectivity within six days. Blood showing large numbers of parasites and Koch's bodies was filtered and the infectivity of the filtrate was tested on bulls, but the result was negative. The serum derived from such blood and treated in the same manner likewise proved non-infective.

Twenty drugs were tested as to their efficacy for this condition, but the results were unsatisfactory. A short series of trials was also carried out to test the value of premunition against the disease and the results were encouraging.

The species of parasite concerned in this form of infection presents a close resemblance to *Theileria dispar*, as described by du Toit [1930]. (*Authors' abstract*)

Pneumonia in foals due to *Corynebacterium equi*. V. R. Rajagopalan (*Ind. J. Vety. Sci. & Anim. Husb.*, **7**, 38)

A particular form of pneumonia is known to occur with some frequency in certain breeding studs in the Punjab, and the etiology of this condition, which was thought to be identical with that described by Magnusson in Sweden, has been under investigation for some time.

The infection is generally confined to foals about one to two months old and, occasionally, symptoms of joint-ill may be seen in addition to those of pneumonia. The mortality is high. *Post-mortem* examination reveals large abscess cavities in the lungs and the mediastinal glands.

Corynebacterium equi, the causal agent, can be recovered in nearly every case in pure culture from the abscesses in the lungs and mediastinal glands, as well as from the fæces, sometimes from the heart-blood and, rarely, from the joint fluid of naturally as well as artificially infected cases. The cultural and biochemical characters of this organism are described.

It has been possible to reproduce the typical symptoms of the disease by an intranasal douche of a saline suspension of the organism. Age, as in natural incidence, appears to be the chief factor in the artificial reproduction of the disease.

Attempts were made to assess the value of vaccination and of treatment with mercourochrome and iodine. The results were inconclusive for want of animals of suitable age in the former case, and for want of controls in the latter. (*Author's abstract*)

The sulphur content of some Indian grasses. F. J. Warth and T. S. Krishnan (*Ind. J. Vety. Sci. & Anim. Husb.*, **7**, 54)

Amongst grasses growing side by side in the natural state, it was found that species of the tribe Chlorideæ contain more sulphate than is present in other species. There was no corresponding excess of sulphur in the proteins of these.

The stalks of grasses contain more sulphate than the leaf. In lucerne the reverse is true. (*Authors' abstract*)

Is there a relationship between the viruses of rinderpest and Doyle's disease? V. R. Rajagopalan (*Ind. J. Vety. Sci. & Anim. Husb.*, **7**, 59)

It has been shown that rinderpest virus does not give rise to Doyle's disease in fowls and *vice versa*, and that no cross immunity occurs between the two viruses. (*Author's abstract*)

NOTES

NUTRITION IN RELATION TO HUMAN BEINGS, FARM LIVE-STOCK AND CROPS

On January 4th a joint discussion on "Nutrition in relation to Human Beings, Farm Live-Stock and Crops" was held at the Indian Science Congress, Hyderabad. The Chairman, Colonel Olver, Animal Husbandry Expert, Imperial Council of Agricultural Research, in opening the discussion, referred to his Presidential Address to the Medical and Veterinary Research Section, in which he had already dealt with this subject. He said that in addition to its broad scientific interest the matter was of the greatest practical importance and urgency and that it was the one above all others which the present Viceroy had most at heart, *viz.*, the better nutrition of the masses. The practical aspect should therefore be kept in the forefront.

To the poor peasant an adequate diet was a matter of pice and annas and to the cultivator, of small capital, costly model buildings and expensive processes meant nothing.

On the other hand there was ample evidence that if suitably assisted, in their villages, to dispose satisfactorily of their produce, whether from crops or animals, the Indian ryot was not slow to find means of taking advantage of such an opportunity of improving his position. His view after years of careful study of the subjoot was that the solution of this problem must lie to a large extent in the development of a well-balanced system of mixed farming in India and in developing such a system it was clear that the greatest possible use should be made of all the resources of modern science ; to secure, under the very varying conditions of soil and climate which exist, the maximum return from the cultivable land available.

In this the provision of better and more remunerative cattle must play an important part and he believed that fodder crops and cultivated grasses should take a much more important place than hitherto. More should no doubt be done to improve and make better use of village and forest grazing, but the tendency at present was to rely too much on free grazing for the maintenance of stock. To produce more money for himself and a better diet for the people, within the reach of the masses, he believed that it would be in the best interest of India if each cultivator would keep and maintain properly, mainly on fodder crops grown on his land, at least one good cow. He could thus produce more and better milk, more manure and better work animals. He felt that free grazing, out of which so much political capital had been made, must to a large extent be a will-o'-the-wisp in a country where the pressure on the land was so great. He quoted figures from the

report of a special commission of forest officers, which had sat recently in Madras, to show that forest grazing could never be an important factor in dealing with this problem though with better care and management, village grazing lands might no doubt be improved.

Finally he mentioned a matter which he felt was of considerable practical importance, *viz.*, the fact that since the milk of buffaloes and cows contained approximately equal percentages of the solids-not-fat, mainly protein and minerals, which are essential to a proper diet, buffaloes' milk heavily watered down as it usually was before it reached the consumer, was not of such high nutritive value, particularly for growing children, as was cow's milk with an equal percentage of butter-fat. Cow's milk, being less rich in cream, will not allow of such heavy watering without detection and its protein and mineral content is therefore higher than that of the buffalo milk usually sold.

Dr. W. R. Aykroyd, Director of Nutrition Research, Indian Research Fund Association, said that many of the observations of the research worker on human nutrition were of great importance to the agricultural and animal nutrition worker, and for the guidance of agricultural and food production policies in the right direction. It was the task of the human nutrition research worker to discover and demonstrate the chief defects of Indian dietaries. This problem could be approached by the study of actual diets consumed by sample groups in towns and villages, and by the investigation of the incidence of food deficiency diseases and various physiological conditions associated with malnutrition. Both these lines of investigation were being followed.

The dietary standards put forward by American and European physiologists such as, for example, the standards recently suggested by an expert commission of the League of Nations, purported to represent the *optimum* and allowed a high margin of safety. Even casual observation at once showed that average Indian diets were deficient when compared with such optimum standards. The nutrition worker in the East might, however, justifiably adopt a lower standard representing a moderately satisfactory diet. But even when he had reduced his demands to a minimum point which might be difficult to justify on scientific grounds, he found that the diets of typical Indian village families were deficient in terms of such minimum standards.

In dietetics " enough food " took precedence over " the right sort of food ". Insufficient data had been accumulated about the calorie-intake of typical Indian village population groups, but what information existed suggested that large sections of the population might not have enough to eat. Tentative analysis of the amount of food available per consumption unit in the Madras Presidency supported this conclusion. He was inclined to estimate the minimum daily requirements per consumption unit of a South Indian peasant family as about 2,500. If the diet of a peasant or labourer fell below this figure, adjustment occurred as follows : basal

metabolism was reduced, the body functioning at a lower level of vitality, and energy output was made consonant with energy intake. In simple terms, the underfed labourer was lethargic, and his output of work small. He reached a kind of dreary adaptation to his environment. But the remarkable capacity of the human body and the human mind to adopt himself to semi-starvation should not influence the nutrition worker in setting up standards of calorie requirements.

If the diet surveys which were to be carried out in various parts of the country showed that there was widespread insufficiency of food, then the first necessity was simply to increase food supply, and this necessity must remain the foundation stone of agricultural policy.

On the qualitative side, typical Indian dietaries showed serious deficiencies. There was a relative lack of animal products such as milk, eggs and meat, of fish ; and also of pulses, vegetables, and fruits. Experiments had shown that the addition of small quantities of skimmed milk to the diet of typical Indian children living on a largely cereal diet, containing no milk or eggs, produce a rapid acceleration of growth and an improvement in general health and vitality. The change which took place brought realisation of the handicaps under which a deficiently fed population labours. It seemed probable that the most serious fault of the average Indian dietetics was their relative lack of one or more of the food factors contained in skimmed milk : proteins of high biological value ; vitamin B_2 ; and assimilable calcium. Probably no food of vegetable origin would supplement average Indian diets as effectively as milk or eggs. Special mention should be made of fish which contained some of the food elements most needed by the poorer classes in India. The fishing industry in India was in a backward state. It was noteworthy that the Japanese, in attempting to improve the diet of the country, had paid great attention to the development of fisheries and had obtained remarkable success in this direction.

Pulses, though rich in vegetable protein, were not of the same nutritive value as milk or eggs. Nevertheless, they contained food factors which were relatively lacking in cereals and particularly in milled cereals. Diet surveys had suggested that the pulse intake of villagers could be increased with advantage, and an adjustment of crop-planning so as to increase pulse production might suitably be made a feature of agricultural policy. Dramatic results in the shape of improved nutrition could not, however, be expected to result from such an adjustment. The soya bean did not appear to have any advantage over the common pulses which already formed part of the Indian diet, and it did not seem desirable that a great deal of time and trouble should be spent on stimulating the production and consumption of this legume in India.

The average Indian villager appeared to consume vegetables and fruits in very small quantities. These foods contained elements needed by the population, green leafy vegetables being particularly valuable. Preliminary investigation

suggested that there might be a great deal of "subclinical" scurvy in India, The most important sources of the anti-scorbutic vitamin—vitamin C—were fresh fruits and green leafy vegetables.

Red palm oil, derived from the fruit of the West African palm, *Elaeis guineensis*, was extremely rich in carotene, the precursor of vitamin A. It was probable that very effective medicinal preparations for the treatment of vitamin A deficiency in human beings could be made with red palm oil as an ingredient, and this oil could be incorporated in the diet in various ways. The plain *Elaeis guineensis* was already grown in Malaya and Burma, and might also be grown in India and produce large quantities of cheap vitamin A for the benefit of the population. Cod liver oil was relatively more expensive. The average Indian diet was deficient in vitamin A, and there was great need for a larger supply of this factor.

While the study of diets actually consumed in India indicated that Indians of the poorer classes consumed an inadequate and ill-balanced diet, another method of approach led to similar conclusions. The clinical examination of groups of school children in towns or villages in South India revealed that a high percentage showed visible symptoms of deficiency disease, one of the commonest being stomatitis due to vitamin B_2 deficiency. Symptoms were observed in a larger percentage of children of the poorer classes than of children of the more prosperous classes. A point of interest was that a higher incidence of deficiency disease was observed among children of the poorer classes in towns and cities than among poor village children. The probable reason for this was that the poor in the towns consumed milled rice, while the villager consumed millet, or rice in the "home pounded" state. The spread of the use of milled rice, while living standards remained at their present level, was definitely to be discouraged.

Further evidence of widespread malnutrition was provided by blood examinations. The hæmoglobin content of the blood of South Indian children was on an average some 20 per cent or more below European standards, and this appeared to be due to an insufficiency of iron in the diet. At present it was difficult to indicate the dietary alterations likely to increase iron intake.

Summarising, Dr. Aykroyd made suggestions regarding the orientation of agricultural policies, and policy in relation to the production and consumption of food in general which seemed to be indicated by human nutrition research.

1. The total food available may be insufficient to meet the quantitative requirements of the population. If this is so, the first and primary need is the production of enough food of whatever kind.

2. The spread of the use of milled rice should be discouraged.

3. The most effective supplements to typical Indian dietaries are animal foods, such as milk, whole or skimmed, eggs and fish. The greater production of milk and eggs may not be immediately possible, and meanwhile the popularisation of

imported milk products may be desirable. The question of removing the duty on imported milk deserves serious consideration.

4. Attention should be given to the development of fisheries, now in a very backward state.

5. Pulse production and consumption should be increased. It does not seem desirable to give special attention to the popularisation of soya bean.

6. Attempts should be made to increase the production of vegetable and fruits which contain elements needed by the population.

7. Red palm oil is a valuable and cheap source of vitamin A. It could probably be produced in India.

Rao Bahadur B. Viswanath, Officiating Director, Imperial Agricultural Research Institute, emphasised the importance of the condition of the soil with reference to the nutritive value of foodstuffs. Manurial treatment of the soil might have the effect of producing crops with a higher vitamin content. The extractability or solubility of proteins in different solvents varied with manurial treatment. Nitrogenous manuring, while increasing the nitrogen content of crops, depressed their phosphate content; on the other hand, phosphate manuring produced a distinct increase in phosphate content, while at the same time protein nitrogen showed a tendency to rise. The supply of organic manures was therefore a question of considerable importance in India.

Dr. K. C. Sen, Officer-in-Charge, Animal Nutrition Section, Imperial Veterinary Research Institute, Izatnagar, presented a note prepared by him in collaboration with Mr. F. Ware, Director of the Institute. He stressed the point that in India the subject of nutrition differed very greatly from the same subject in most other countries of the world in the fact that, while it was necessary to provide sufficient fodder for an enormous population of transport animals, there was no possibility of directly converting these animals into food for the human population at any stage of their existence. The result of this was that to a large extent the human and animal populations of India would always be in competition for the food which can be grown on the available land.

Colonel Bhatia, Professor of Physiology, Grant Medical College, Bombay, emphasised the importance of nutrition in relation to public health. There was abundant evidence that the standard of nutrition in India was very low. Poverty was an important factor in producing malnutrition, but it should also be remembered that diet in India was regulated by custom, tradition, and religious sanction which made the task of the reformer and public health worker extremely difficult. Colonel Bhatia referred to the valuable work of the League of Nations in the field of nutrition. Recent reports of the League had particularly emphasised the value of the "protective" foods, *viz.*, meat, eggs, fresh milk, fresh vegetables, and fresh fruit. The speaker drew particular attention to the enormous amount of ill-health in pregnant and nursing mothers, due to improper and incomplete diet, in many

parts of India. Pregnant and lactating women needed an abundant supply of good milk. Diet was also of the greatest importance in infancy and early childhood. Here again milk is the crux of the problem.

Efforts should be made to educate the public in dietetics. The scientist had far too long been living a life of proud seclusion. It was high time that the valuable knowledge gained by patient research should be broadcast for the welfare of the people. For progress on a nation-wide scale a concerted effort on the part of the people and the Governments was necessary.

Sir Akbar Hydari said that as a practical administrator, he had learned much during the meeting. The time had come to consider whether a greater proportion of public funds should not be devoted to improving the nutrition of the people, rather than to less vitally important objects.

Mr. Y. D. Wad, Indore, discussed the improvement of the quality and quantity of crops by means of enriching the soil. The problem of nutrition seemed to include in its scope the betterment and maintenance of soil condition.

Dr. N. C. Wright, at present touring India to advise on the development of the dairying industry, said that all the speakers had emphasised the high nutritional value of milk and milk products. He stressed the necessity of establishing a better balanced system of agriculture, including a greatly enlarged dairy industry.

Dr. V. Subramanyan, Indian Institute of Science, Bangalore, discussed problems relating to the quality of foodstuffs.

Dr. K. P. Basu, University of Dacca, referred to the importance of investigating the biological value of proteins.

Colonel Olver in summing up said that the main point which appeared to have been clearly brought out was that a larger proportion of the "protective" foods of animal origin was essential in order to improve the diet of the people of India. The great importance of an increase in the present consumption of milk had been strongly emphasised by almost every speaker and it seemed clear that far more attention needed to be paid to dairying than had been the case in the past. His own view was that a better-balanced system of agriculture was the only feasible way in which a greater and cheaper supply of milk could be secured.

By obtaining the greatest possible return from the land such a system would enable the ryot to make money from milk or ghee, to provide better food for his family. At the same time it would enable him to produce better working bullocks and more and better farmyard manure, and would increase the return from crops. An increased and cheaper supply of milk and better work animals could thus be produced on every holding of sufficient extent. The feeling of the meeting had been very clear that, in order to provide a satisfactory diet for the people of India, it was essential to do everything possible to increase and cheapen the supply of milk and dairy products. They all recognized the absolute necessity for keeping the cost of the diet as low as possible but upto the present it had not been found feasible to

replace the protective foods of animal origin by the cheaper vegetable foods. Sound milk was recognized to be the best and cheapest of all foods but he would like also to mention eggs and poultry as valuable sources of animal protein. More poultry could easily be kept in every village if properly managed, and would cost little to maintain since the grain they consumed would otherwise to a large extent be wasted, while there was usually an abundance of insect life which formed an important part of the diet of poultry.

He mentioned that the value of poultry and poultry products in Great Britain at present exceeded the total value of the wheat crop.

Only by making the greatest possible use of every available source of foods of animal origin, such as milk and eggs, which were of high dietetic value, could the diet of the people of India be made a satisfactory one and the most feasible way of providing such foods seemed to be by mixed farming, but more attention should also be paid to subsidiary sources such as fish.

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FOURTH INTERNATIONAL GRASSLAND CONGRESS

The Fourth International Grassland Congress is to be held in Great Britain in July 1937, under the Presidency of Professor R. G. Stapledon, C.B.E., M.A., Director of the Welsh Plant Breeding Station and the Imperial Bureau for Herbage Plants, Aberystwyth, Wales. The previous Congresses in this series have been held in Europe and membership was more or less confined to European members, but delegates will come to this Fourth Congress from Great Britain, the British Dominions and Colonies, U. S. A. and numerous other countries—members of the International Grassland Congress Association (Central Office in Leipzig, Germany).

The paper-reading sessions will be held in Aberystwyth from July 13th to 19th, but intending participants will be able to join in a tour of centres of grass land interest and selected farms both before and after these sessions. The tour will be made partly by motor coach and partly by rail.

Delegates can choose one of the following options :—

	July
(1) Attending paper-reading sessions and local Aberystwyth tours only	13—19
(2) Assembling at Oxford, proceeding *via* selected centres of grassland interest to Aberystwyth and participating in sessions and local tours	8—19
(3) Attending paper-reading sessions and local tours, and proceeding from Aberystwyth to Newcastle, and Edinburgh where disperse	13—23
(4) Assembling at Oxford, proceeding to Aberystwyth, attending paper-reading sessions, and local tours, and proceeding thence to Edinburgh, *i.e.*, the whole tour, of which options, 1, 2, and 3 are only parts . . .	8—23

The tours have been so arranged that participants will have an opportunity to see something of British grassland farming, including live-stock management, over as wide a range as possible. The limits of what can be done have been set by the amount of time available, and the obvious necessity for curtailing charges to delegates.

Special addresses will be given on certain evenings during the course of the tour, when matters of general interest emanating from the tours will be dealt with. Those addresses will be given at Oxford, Cirencester, Aberystwyth and Newcastle.

Approximate quotations are now given for the cost of the tours. Participants selecting option (1) will be expected to pay the Congress Fee of two pounds (sterling) but to find their own accommodation in Aberystwyth. A list of approved hotels, hostels, etc., in Aberystwyth and the neighbourhood can be obtained from the Joint Secretaries. The charges for the other three options are as follows :—

Option (*2*).—Transport, and accommodation in colleges where possible £11. Hotel accommodation can be provided at £13 per head.

Option (*3*).—Transport, and accommodation in colleges where possible £11. Hotel accommodation can be provided at £13 per head.

Option (*4*).—The complete tour. Transport, and accommodation in colleges where possible £18. Hotel accommodation can be provided at £21 per head.

Alternative rates can be quoted for those intending to provide for their own transport on tour.

As already stated the Congress fee for the Fourth Congress is two pounds sterling, which will entitle members to attend all sessions and to receive the printed transactions, including all abstracts in advance of the Congress meetings, and any other incidental matter relating to the Congress. The Congress fee for wives accompanying members will be one pound sterling and will admit to full membership but will not entitle such members to receive a copy of the transactions.

The paper-reading sessions to be held in Aberystwyth will be divided into three plenary and two sectionalized sessions. The sectionalized sessions will deal with the following aspects of the grassland problem.

(1) Ecology (including surveys), pasture and range management (including erosion control).

(2) Seeds mixtures (including lucerne for grazing) ; legumes for use in poor pastures.

(3) Plant breeding, genetics, and seed production.

(4) Manures and fertilizers.

(5) Nutritive value of pastures ; fodder conservation.

(6) Grassland economics.

All particulars regarding the acceptance of papers and dates for receipt of abstracts and paper manuscripts may be had from the Joint Secretaries, Agricultural Buildings, Aberystwyth, Great Britain, to whom requests for the Preliminary Programme and application form for membership and all other correspondence regarding the Congress should be addressed.

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THE WORLD PRODUCTION OF LINSEED

THE following communication has been received from the Press Bureau of the International Institute of Agriculture, Villa Umberto, Rome :—

The latest estimates of production communicated to the International Institute of Agriculture by Germany, Roumania and Bulgaria in November and December, confirm for 1936 a European linseed crop larger than that of 1935 and decidedly above the average. The factor which has determined the increase in volume of European production is essentially the extension of flax cultivation for seed which, after a somewhat marked decline from 1929 to 1931, has shown a steady recovery in nearly all the producing countries.

Among the countries which have especially intensified linseed growing special mention may be made of Germany, which, although this crop was introduced only a few years ago, already occupies the third place in European production (not including the U. S. S. R.), standing immediately after Poland and Lithuania.

There is still no production estimate for the U. S. S. R., but, contrary to what has been the case in the flax-growing countries of Europe, the crop has been for some years on the decline.

However, the information available as to the course of the season, which has been on the whole favourable to the development of the crop, and as to the measures adopted by the Soviet Government with regard to the improvement of the product in quality, points to a more abundant linseed harvest than that of 1935, and one also somewhat exceeding the average, calculated at 16,800,000 centals (29,900,000 bushels).

The Soviet production of linseed, although considerable, has no importance for world trade, as its volume is almost entirely absorbed by the requirements of the internal market.

In North America the present season has been characterized by very poor crops, due mainly to the exceptional dry weather in the spring and to the great heat of the summer.

In the United States, the December estimate confirms an extremely slender production, scarcely 550,000 centals (1,000,000 bushels) more than the disastrously small crop of 1934. In Canada the estimate of production made in October shows

an increase of about 21 per cent, as compared with 1935, but it remains lower by 24·6 per cent, than the preceding five-year average.

Taken as a whole, the production of the two North American countries remains very poor, hardly reaching 4,300,000 centals (7,700,000 bushels) a decrease of more than 50 per cent on that of 1935 which was calculated at 8,700,000 centals (15,600,000 bushels), and of 44·5 per cent on the average figure of the previous five years, taken as 7,800,000 centals (13,900,000 bushels).

In Argentina the first estimate of production, amounts to 41,400,000 centals (74,000,000 bushels). As already forecasted in the Crop Report of October, this estimate virtually coincides with the preceding five-year average, being scarcely 220,000 centals (400,000 bushels) lower, but exceeds by nearly one-third the definitive figure of last season, which was recently brought up to 31,400,000 centals (56,100,000 bushels).

On the basis of the production as estimated in advance and taking into account the quantities which will be absorbed by the national linseed-oil industry and by the seed reserve and the almost negligible stocks of the past season, the Argentine Government has estimated at 38,100,000 centals (68,100,000 bushels) the exportable surplus for 1937.

Uruguay up to the present has not yet communicated any estimate of the area set aside for linseed in the season 1936-37. From non-official information, however, an extension of the area is expected and good results seem likely, as in Argentina.

In India, which occupies the second place among the linseed-exporting countries, the season has been on the whole favourable to the crop but, owing to damage caused by bad weather at the time of harvesting, the volume of production shows a decrease of about 9 per cent as compared with 1935 and of 1·3 per cent as compared with the average, in spite of the fact that the area utilized for linseed has remained practically without variation as compared with previous year and exceeds the average by 9·1 per cent.

Among the African countries the most important linseed-growing country is French Morocco. Here on an area nearly equivalent to that of last year but less than the average by some 22 per cent a crop has been obtained exceeding by 29·6 per cent the very small one of 1935, which was seriously damaged by the spring drought, but at the same time 28·4 per cent less than the average of the five preceding years.

To sum up, taking account of the estimates already available, which refer to the majority of the producing countries, and of the information relating to the crop for the other countries which have not yet made production estimates, world production of linseed in 1936-37 (not including the U. S. S. R.) may be estimated at between 62 and 64 million centals (110 and 114 million bushels) as compared

with 56·7 (101·2) in 1935 and 63·7 (113·8) on the average of the preceding five-year period.

It follows that, in spite of seriously short harvests in North America and of the losses which have reduced Indian production, the 1936-37 linseed season may be classed among the years of fairly abundant harvests, a position mainly due to the favourable results anticipated in Argentina and to the increase in European production.

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THE WORLD PRODUCTION OF FRESH COCOONS AND RAW SILK IN 1936

THE following communication has been received from the Press Bureau of International Institute of Agriculture, Villa Umberto, Rome :—

On the basis of the official data, unofficial estimates and other information received by the International Institute of Agriculture, the following is a summary of the results of the 1936 sericultural season.

The season appears generally favourable in Europe save in Greece and, thanks to the market revival in Italy, total European production of fresh cocoons will this year be considerably larger than in 1935, being estimated, in fact, at about 80·5 million pounds, 55 per cent above that of the preceding year, but 18 per cent below the 1930-34 average of 98·1 million, the decline of rearing in Europe has been very great in recent years, especially from 1931 onward ; previously European production of fresh cocoons oscillated on the average around 132 million pounds.

In Asiatic countries the weather was in some cases unfavourable but results were on the whole fairly good and not very different from those of last year ; for the total of these countries, excluding China and India, production of fresh cocoons is estimated this year at 761·0 million pounds against 779·3 million in 1935 (2·3 per cent less) and 895·1 million the average of 1930-34 (15·0 per cent less), these years including two or three of very large production ; in this connection it may be noted that Japanese production alone amounted to about 882 million pounds of fresh cocoons in 1930 and 838 million in 1933 against 758 million the average of the five years 1925-29.

Very favourable weather has contributed to the recent rapid development of silkworm-rearing in Brazil ; the production of this country is still, however, of small importance in the world total. There is also a very notable increase in the Soviet Union (Central Asia and Transcaucacia) to meet the growing requirements of the internal silk industry ; from an average of 25·6 million pounds of fresh cocoons in 1926-29, production rose to 34·6 million in 1930-34 and about 46·3 million this year.

In the few African countries rearing silkworms to a very limited extent (Egypt, Tripolitania) weather during the season was in general unfavourable and results poor.

World production of fresh cocoons, not including China and India, is estimated this year at 889·1 million pounds, against 872·8 million in 1935, 1,028·9 million in 1930-34 and 991·6 million in 1925-29. On the basis of present cocoon production and with a necessarily approximate calculation, world production of rawsilk in 1936, excluding China and India, may be estimated at 84 million pounds.

At the end of the 1935-36 season total visible stocks of raw silk were estimated at about 17,640,000 pounds, as against 22,100,000 on June 30th, 1935 and 28,660,000 on the same date in 1934. The constant decrease in the stocks of raw silk on the principal markets during the last three years might constitute during the present season one of the factors in favour of a rise in the price of this product in the more important importing and exporting countries, the more so as the world production of raw silk in 1936 is expected to be somewhat deficient and very probably lower than the average for the last ten years.

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RINDERPEST CONTROL IN INDIA

In the November 1936 number of *Agriculture and Live-stock in India* (p. 868) an article was reproduced from the public press which, though it referred specifically to the vaccination of cattle against rinderpest with goat virus, has apparently been read indicating that such inoculation is also safe for buffaloes. For many parts of India that appears to be usually the case but, in view of the danger of such an assumption, it is considered desirable to point out here that considerable mortality has taken place among buffaloes in certain areas. In the official note* issued on the subject of rinderpest control by the Imperial Council of Agricultural Research this danger has been sufficiently drawn attention to and, in the case of buffaloes, the use of a small dose of anti-rinderpest serum along with goat virus is advocated.

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INTERNATIONAL ORGANISATION OF THE RUBBER MARKET

The following communication has been received from the Press Bureau of the International Institute of Agriculture, Villa Umberto, Rome :—

Amongst important cases of international agreements between producers for the purpose of influencing the prices of particular raw materials, the example of rubber is particularly worthy of notice. The first experiments in regulating production and exports of this product date from 1921 in consequence of the crisis due to the lack of balance between production and consumption. The Stevenson

* This *Journal* 6, 626.

Plan, which was in force from October 1922 to November 1928, brought about an appreciable rise in prices, until the reaction of consuming countries in diminishing their consumption by using reclaimed rubber and buying rubber plantations, without reckoning the increase in production in countries not bound by the plan, and in native production, cancelled the advantages obtainable from this attempt at planned economy in the domain of agriculture.

The International Institute of Agriculture of Rome, has recently presented in its Review a thorough study, based on full statistics, of the problems of international organisation on the rubber market. The author shows that, after the abolition of the Stevenson Plan, all the producers concerned felt the need of some regulation of production and that there was signed on 7 May 1934 the international agreement for the regulation of production and exports of rubber in British Malaya, the Netherlands East Indies, Ceylon, India, French Indo-China, Northern Borneo, Sarawak and Siam.

From this study it will be seen that rubber production has been characterized by a remarkable increase in recent years, rising from 996,500 tons (long tons) in 1933 to 1,254,000 tons in 1936. Hence world stocks remain high and were estimated at 575,000 tons in 1935. On the other hand two factors favourable to the producers were observed; a certain increase in world consumption, which rose from 939,200 tons in 1934 to 947,600 tons in 1935, and also a rise in prices, the quotations for First Latex Crepe on the London market having gone up from an average of 3 1/3*d*. in 1933 to 7 7/16 for the first months of 1936.

The effects of the new agreement were thus a rise in prices but the situation is not yet wholly satisfactory, for consumption has not followed the trend of production; it is thought therefore by some that the action of the international Committee set up by the agreement should rather be directed towards the development of consumption. The agreement between producing countries will end in 1938, but the results obtained lead to the belief that it will be renewed.

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BIHAR VETERINARY COLLEGE, PATNA

THE following notification has been received from the Principal, Bihar Veterinary College, Patna :—

The next session of the Bihar Veterinary College will commence from the 1st July 1937.

1. A candidate desiring admission should submit his application on the prescribed form, together with the following certificates in original, so as to reach the Principal on or before the 1st June, 1937.

(*a*) Age and moral character certificate from the Headmaster of the School or Principal of the college at which he last read.

(*b*) University certificate or a certificate from the School or University authorities to show that he has passed the Matriculation Examination,

(*c*) Medical Certificate of fitness from an Assistant Surgeon.

(*d*) Letter from his guardian stating that all expenses incurred by his ward during the latter's period of study at the college will be paid.

(*e*) Letter of identification from some well-known person stating that the candidate is known to him and the statements made in the application form are correct.

2. A candidate for a District Board stipend to assist him while under training at the college should apply *in the first instance* to the Chairman of his home district board, with the necessary certificates as soon as possible so that when selected he may be interviewed and approved by the Director of Veterinary Services, Bihar, before he is recommended for admission. Such a candidate should in addition to the certificates required in paragraph 1, produce at the time of admission a letter from the Director of Veterinary Services, Bihar, or the Chairman, District Board concerned, regarding his selection as a stipendiary.

3. An applicant must be a Matriculate of a recognised University. Preference will be given to a candidate who has passed the I.A. or I.Sc. Examination. A good knowledge of English is essential. Height should not be under 5′-4″ and chest unexpanded, not less than 30 inches. A candidate must not be below 16 and over 25 years of age.

4. A non-stipendiary candidate will have to appear before the Governing Body of the college when called for interview.

5. Fees must be paid in advance according to the scale under rule 8 of the college rules, the initial payment due at the time of admission being Rs. 35-8 only.

6. A candidate will reside in the college hostel from the date of his admission unless specially exempted.

7. Admission forms may be had free on application to the Principal. *Prospectus will be supplied on receipt of As. 4 by Money Order for each copy required.*

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BOARD OF AGRICULTURE AND ANIMAL HUSBANDRY.

CROPS AND SOILS WING, 1937

AT the invitation of the Punjab Government, the second meeting of the Crops and Soils Wing of the Board of Agriculture and Animal Husbandry will be held at Lahore from the 6th to the 11th December 1937, both days inclusive. The 8th and 9th December will be spent on a tour of inspection at Lyallpur. His Excellency the Governor has very kindly consented to open the Board's deliberations.

PLANT QUARANTINE AND OTHER OFFICIAL ANNOUNCEMENTS

JERSEY (CHANNEL ISLANDS)

General Regulations under the Act of the Committee of Agriculture of April 28, 1930, as amended by that of April 5, 1933

IMPORT REQUIREMENTS

Article 1.—THE landing in the Island of Jersey of any of the plants mentioned in the First Schedule to this Act from any country other than Great Britain, Ireland, the Isle of Man, and the other Channel Islands, is prohibited except in accordance with the following provisions :

Authorised port of entry

(*a*) The plants may be landed in the Port of St. Helier only.

Phytosanitary certificate required

(*b*) Each consignment must be accompanied by two copies of a certificate issued by a duly authorised official in the country whence the plants are exported, in the form prescribed in the Third Schedule of the Act. One copy must be produced to the Harbour Master and the other copy must be forwarded by the importer to the consignee. In the case of mail shipments a copy of the certificate need not be produced to the Harbour Master but a copy must be affixed to each package. The original of the certificate must be mailed to the Committee of Agriculture by the exporter before the plants are shipped.

Inspection may be required

(*c*) The Committee reserves the right to cause any package or parcel containing plants imported or believed to have been imported into the Island to be opened and examined whether or not the provisions of this Act have been complied with.

Inspection required in the absence of certificates

(*d*) In the case of importations of plants from a country in which there is no official duly authorised to issue the certificate mentioned above, and of consignments which are not accompanied by the copy certificate required by this Act, and in the case of plants sent by mail to which such copies are not attached, the plants shall be retained by the Harbour Master until such time as the Committee of Agriculture shall have caused them to be examined.

Plants for scientific purposes exempt

Article 2.—The provisions of this Act do not apply to plants the landing of which is authorised by a general or special license issued by the Committee or to consignments of plants to the Committee for experimental or scientific purposes.

SCHEDULE I

Restricted plant material

(*a*) All living plants with a persistent woody stem above ground, and parts of the same except seeds, when for use in propagation, such as fruit trees, stocks and stools, forest trees, and ornamental shrubs, and grafts, layers, and cuttings thereof.

(*b*) All potatoes; and all tubers, bulbs, rhizomes, corms, and hop stocks for planting.

(*c*) Seeds of onions and leeks for sowing.

(*d*) All unrooted cuttings and rooted plants of chrysanthemums.

SCHEDULE II

Plant parasites

Fungi—

Black-knot of plum and cherry, *Plowrightia morbosa* (Schw.) Sacc.
Fire blight of apple and pear, *Bacillus amylovorus* (Burr.) Trev.
Chestnut blight or canker, *Endothia parasitica* (Murr.) And. and And.
Wart disease of potatoes, *Synchytrium endobioticum* (Schilb.) Perc.
Smut of onion and leek, *Urocystis cepulae* C. C. Frost.
Downy mildew of hops, *Peronoplasmopara humuli* Miy. and Taka.

Insects—

Grape phylloxera, *Phylloxera* (*vastatrix*) *vitifoliae* (Planch.) Fitch.
An American apple capsid, *Heterocordylus malinus* Reut.
Apple redbug, *Lygidea mendax* Reut.
Pear tingid, *Stephanitis pyri* Fab.
Colorado potato beetle, *Leptinotarsa decemlineata* Say.
Plum curculio, *Conotrachelus nenuphar* Herbst.
Potato tuber worm, (*Phthorimaea*) *Gnorimoschema operculella* Zell.
Eastern tent caterpillar, *Malacosoma americana* Fab.
Forest tent caterpillar, *Malacosoma disstria* Hubn.
Oriental fruit moth, (*Cydia*) *Grapholitha molesta* Busck.
San Jose scale, *Aspidiotus perniciosus* Comst.
White peach scale, (*Diaspis*) *Aulacaspis pentagona* Targ.
Apple fruit fly, *Rhagoletis pomonella* Walsh.
European cherry fruit fly, *Rhagoletis cerasi* L.
Cherry fruit fly, *Rhagoletis cingulata* Loew.
Black cherry fruit fly, *Rhagoletis fausta* Osten Saken.
Current fruit fly, *Epochra canadensis* Loew.
Chrysanthemum gall midge, *Diarthronomyia hypogaea* Loew.

SCHEDULE III

Prescribed inspection certificate

" This is to certify that the plants included in the package or consignment described below were thoroughly inspected by....................a duly authorised official of ......on (date) , and were found or believed by him to be healthy and free from any of the plant diseases or pests named in the Second Schedule to the Act of the Committee of Agriculture of the States of Jersey of April 28, 1930. "

It is understood that all cuttings and rooted plants of chrysanthemums imported from abroad must be accompanied by the certificate prescribed in this Schedule.

Additional certificate for potatoes

" Further, it is hereby certified that no case of the disease known as wart disease or black scab of potatoes (*Synchytrium endobioticum*) has occurred on the farm or holding where the potatoes included in this consignment were grown, nor within 500 yards (about 1/2 kilometer) thereof. "

Signature ....

Official title ....

DESCRIPTION OF SHIPMENT

Number and kind of packages
Marks
Description of plants
Grown at
Name and address of exporter
Name and address of consignee
Name of vessel
Date of shipment
Port of shipment
Port of landing
Approximate date of landing

SPECIAL QUARANTINES

RESTRICTIONS ON THE IMPORTATION OF POTATOES

Potatoes from all sources except Great Britain and Ireland : The Act of the Committee of Agriculture, No. 34, of April 28, 1930, prohibits the importation of potatoes susceptible to the wart disease, *Synchytrium endobioticum*, from *whatever source*. This is based upon the Official List of Varieties of Potatoes, with their synonyms, immune from and susceptible to Wart Disease, published under the authority of the National Institute of Agricultural Botany, in England.

GRADING REQUIRED OF APPLES FROM THE UNITED STATES

As applying to the Channel Islands, the Act of the Committee of Agriculture, No. 35, of July 24, 1930, places the same restrictions upon the importation of apples

from the United States as are imposed by the "Importation of Raw Apples Order of June 21, 1930, of England and Wales".

IMPORTATION OF PEAT PROHIBITED

The Act of the Committee of Agriculture of April 6, 1935, prohibits the importation of peat of any kind, moss litter, and leaf mold from all sources, except the product called "bacterized peat" from England and Scotland, under certification as to its character.

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ISLAND OF GUERNSEY

GENERAL REGULATIONS

(Ordinance IX, Feb. 15, 1936, of the Royal Court of Guernsey)

DEFINITIONS

Article 1.—IN these regulations, unless the context otherwise requires:

"Board" means the Board of Administration of the States of Island of Guernsey.

"Islands" means the Islands of Guernsey, Sark, Herm, and Jethou.

"Plant" in the case of sugar beet and mangold includes living plants and parts thereof except seeds, and in all other cases includes tree and shrub, and the fruit, seeds, tubers, bulbs, corms, rhizomes, roots, layers, cuttings, and other parts of a plant.

"Raw vegetables" includes raw onions, raw tomatoes, raw eggplants, and raw salads.

"Unhealthy" means affected with any insect, fungus, or other pest destructive to agricultural or horticultural crops.

Application of the regulations

Article 2.—Nothing in these regulations shall be deemed to prohibit or restrict the landing or transhipment in the Islands or any of them of any plant or produce (other than potatoes) grown in the United Kingdom of Great Britain and Northern Ireland, the Irish Free State, the Isle of Man, the Island of Jersey, or the Island of Alderney, or in any other of the Islands.

Potato restrictions

Article 3.—(1) The landing in the Islands of any potatoes grown in the under-mentioned countries is prohibited.

The United States of America, the Dominion of Canada, European France, and European Belgium.

(2) The transhipment in the Islands or any of them of the potatoes specified in sub-section (1) of this article is prohibited except under and in accordance with the conditions of a license issued by the Board.

(3) In this article "potatoes" includes haulms, leaves, and stalks.

Importation of sugar beet and mangold prohibited

Article 4.—For the prevention of the introduction of virus diseases of sugar beet and mangolds, the landing in the Islands or any of them from any country other than the United Kingdom of Great Britain and Northern Ireland, the Irish Free State, the Isle of Man, the Island of Jersey, the Island of Alderney, or any other of the Islands of any living plant of sugar beet or mangold (*Beta vulgaris* L.) is hereby prohibited except under and in accordance with the conditions of a license issued by the Board.

Phytosanitary certificate required for plants

Article 5.—(1) The landing in the Islands or any of them of any of the plants mentioned in the First Schedule to these regulations, and of potatoes (other than potatoes grown in any other of the Islands) is hereby prohibited, unless such consignment is accompanied by two copies of a certificate of a duly authorised official of the Phytopathological Service of the country in which the plants or potatoes were grown in the form prescribed in the Second Schedule to these regulations. The inspection referred to in the certificate shall be carried out not more than 14 days prior to the date of shipment. The original of the certificate shall be mailed by the exporter to the States Supervisor, States Office, Guernsey, before the plants or potatoes are despatched. Except in the case of shipments imported by mail, a copy of the certificate shall be delivered to a Guernsey customs officer at the same time as and together with the entry relating to the shipment. In the case of shipments imported by mail, a copy of the certificate shall be affixed to each package. (In this connection State as well as Federal certificates are acceptable).

Restrictions on the importation of raw vegetables

Article 6.—(1) The landing in the Islands of any raw vegetables grown in European France or European Belgium is prohibited.

(2) The landing in the Islands of any raw vegetables *not* grown in European France or European Belgium is hereby prohibited unless each consignment is accompanied by a certificate of origin visaed by a competent authority in the country of origin, indicating the country and place where the produce was grown. The certificates prescribed in this article shall be delivered to a Guernsey customs officer at the same time and together with the entry relating to the consignments.

(3) Nothing contained in this article shall be deemed to permit the landing or transhipment in the Islands of any potatoes of which the landing or transhipment is prohibited or restricted under article 3.

Restrictions on the importation of raw apples

Article 7.—(1) The landing in the Islands or any of them of any cider apples grown in any European country other than France or Belgium is hereby prohibited unless accompanied by a certificate of origin visaed by a competent authority of the country of origin, indicating the country and the place where the apples were grown.

(2) The landing in the Islands or any of them of any cider apples grown in European France or European Belgium is hereby prohibited.

(3) The landing in the Islands or any of them between July 7 and November 15 in any year of any raw apples grown in the United States of America is hereby prohibited unless each consignment is accompanied by a certificate signed by a duly authorised inspector of the Federal Department of Agriculture in the prescribed form.

(4) The certificates prescribed in this article shall be delivered to a Guernsey customs officer at the same time and together with the entry relating to the consignment.

Article 8.—Prescribes the procedure in the event that plants and plant products are landed in the Islands in contravention of these regulations.

Article 9.—Defines the powers of an inspector, and the remaining regulations do not concern the exporter.

FIRST SCHEDULE

All plants and parts thereof (except seeds) for planting.

SECOND SCHEDULE

This is to certify that the living plants/a representative sample of the living plants* included in the consignment, of which particulars are given below were/was*/ thoroughly examined on (date) by (name of inspector), a duly authorised official of the (name of the plant protection organization), and found to be healthy, no evidence of the presence of any insect, fungus, or pest destructive to horticultural crops having been found in them.

The following additional certificate must be furnished for all potatoes :

It is further certified that no case of the disease known as "wart disease" or "black scab" of potatoes (*Synchytrium endobioticum*) has occurred at any time on the farm or holding where the potatoes included in the consignment were grown nor within 2 kilometers thereof.

The following additional certificate must be furnished in the case of every consignment not consisting wholly of potatoes :

It is further certified that the consignment does not contain any plant of sugar beet or mangold.

Signature ....
Official status..................
Date ....

Number and description of packages
Distinguishing marks
Description of living plants or parts thereof
Stated to be grown at
Name and address of exporter
Name and address of consignee

IMPORTATION OF GRAPEVINES PROHIBITED

(Ordinance of September 30, 1895, relating to the grapevine phylloxera)

Article 1.—The importation of grapevines, stocks, cuttings, or scions thereof into Guernsey is prohibited under penalty of their confiscation and immediate destruction and a fine imposed upon importer, consignee, or possessor of such plants.

* Omit what is not applicable.

Provisions for introduction of new varieties

Article 2.—However, any person desiring to introduce a new variety of grape into Guernsey may apply to the Royal Court for a permit. That Court may authorise the importation of scions of the new variety, in the quantity determined by the Court, in hermetically closed boxes consigned to a person designated by the Court for inspection and cleaning at the expense of the importer, before delivery to the latter. Diseased scions will be destroyed.

*

* *

SCOTLAND

The Importation of Plants (Scotland) (Amendment) No. 3 Order of 1936, dated December 21, 1936, is reprinted from the Gazette of India, January 30, 1937.

The Department of Agriculture for Scotland, by virture and in exercise of the powers vested in them under the Destructive Insects and Pests Acts, 1877 to 1927 (*a*) and of every other power enabling them in that behalf, do order and it is hereby ordered as follows :—

MODIFICATION OF THE IMPORTATION OF PLANTS (SCOTLAND) ORDER OF 1933

1. The Importation of Plants (Scotland) Order of 1933 (*b*) (herein referred to as the "principal Order") as modified by the Importation of Plants (Scotland) (Amendment) Orders of 1934 (*c*) and 1936 (*d*) (*e*) (herein referred to as the "Orders of 1934 and 1936") is hereby further modified in the manner provided by this Order.

Restriction on the landing in Scotland of plants, potatoes, raw vegetables and cider apples grown in Germany or Luxemburg

2. The provisions of the Importation of Plants (Scotland) (Amendment) No. 2 Order of 1936 (*e*) with respect to plants, potatoes, raw vegetables and cider apples grown in Belgium shall apply to plants, potatoes, raw vegetables and cider apples grown in Germany or Luxemburg provided that such provisions shall be applied as if where the words "Belgium" and "Belgian" occur in such Order, including the First Schedule thereto, there were substituted in the case of plants, potatoes, raw vegetables and cider apples grown in Germany the words "Germany" and "German" respectively, and in the case of plants, potatoes, raw vegetables and cider apples grown in Luxemburg the word "Luxemburg".

(*a*) 40-1 V. c. 68, 7 E. 7. c. 4, and 17-8 G. 5 c, 32.

(*b*) S. R. & O. 1933 $\frac{\text{(No. 586)}}{\text{S. 31)}}$.

(*c*) S. R. & O. 1934 $\frac{\text{(No. 702)}}{\text{S. 41)}}$.

(*d*) S. R. & O. 1936 $\frac{\text{(No. 7)}}{\text{S. 1.)}}$.

(*e*) S. R. & O. 1936 $\frac{\text{(No. 352)}}{\text{S. 14)}}$.

Commencement

3. This Order shall come into operation on the eleventh day of January, nineteen hundred and thirty-seven.

Short title and construction

4. This Order may be cited as the Importation of Plants (Scotland) (Amendment) No. 3 Order of 1936 and shall be read as one with the principal Order and the Orders of 1934 and 1936 and those Orders and this Order may be cited together as the Importation of Plants (Scotland) Orders of 1933 to 1936.

In witness whereof the Department of Agriculture for Scotland have hereunto set their Official Seal this twenty-first day of December, nineteen hundred and thirty-six.

P. R. LAIRD.

(L. S.)

An Order in similar terms applicable to England and Wales has been issued by the Ministry of Agriculture and Fisheries, London.

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COLUMBIA

(*Translation of note in Bogota evening paper, EL. ESPECTADOR, of 17th December 1936.*)

By decree of this morning the National Government has strictly prohibited the importation of sugar cane seeds from abroad, with the exception of sugar cane seeds imported, on prior authorisation from the Ministry of Agriculture and Commerce, from the following experimental stations : Federal Experimental Station of Mayaguez of Porto Rico ; experimental station of the University of Porto Rico ; plants industry section of the Department of Agriculture of the United States, Washington.

These seeds must be accompanied by a health certificate issued officially by the corresponding pathologist.

Similarly interdepartmental traffic of sugar cane seeds is prohibited. Governors will ensure the strict compliance with the dispositions of this decree through the employees of the Revenue Department.

Fines of 100 to 300 pesos will be imposed for infractions of this decree.

These measures have been taken in view of the fact that sugar cane is susceptible to infectious diseases and insect plagues which affect the yield, and to the fact that a grave epidemic of ' mosaico ' has presented itself in neighbouring countries.

Personal Notes, Appointments and Transfers, Meetings and Conferences, etc.

THE names of the following recipients of New Year Honours will be of interest to the Agricultural and Veterinary Departments in India :—

C.I.E. : RAO BAHADUR TIRUVADI SAMBASIVA IYER VENKATARAMAN, B.A., Indian Agricultural Service, Sugarcane Expert, Imperial Cane Breeding Station, Coimbatore.

Sardar Sahib : SARDAR LABH SINGH, L.Ag., B.Sc. (Agri.), Punjab Agricultural Service, Offg Professor of Agriculture, Agricultural College, Lyallpur, Punjab.

Khan Sahib : MR. BAZLUL KARIM, Superintendent, Imperial Council of Agricultural Research Department, Government of India.

Khan Sahib : MR. ABDUL GHANI, Veterinary Deputy Superintendent, Biological Products Section, Imperial Veterinary Research Institute, Izatnagar, United Provinces.

Khan Sahib : MR. GHULAM HUSSAIN, P. V. S., Deputy Superintendent, Civil Veterinary Department, Rohtak, Punjab.

Khan Sahib : MR. MUBARIK ALI SHAH, M.R.C.V.S. (Lond.)., B.Sc. (Hons.), Superintendent, Civil Veterinary Department, N.-W. F Province.

Rao Sahib : MR. MANJESHWAR ANANTA NARAYAN RAO, G.M.V.C., Lecturer in Parasitology, Veterinary College, Madras.

The Imperial Council of Agricultural Research

Under Rules 1 (14) and 22(14) of the Rules and Regulations of the Imperial Council of Agricultural Research, SIR JOSEPH KAY has been elected by the Associated Chambers of Commerce of India and Ceylon as their representative on the Imperial Council of Agricultural Research and on its Governing Body, *vice* MR. R. SCHERER, resigned.

COL. A. OLVER, C.B., C.M.G., F.R.C.V.S., Animal Husbandry Expert, Imperial Council of Agricultural Research, has been granted leave on average pay *ex*-India for four months, with effect from the 4th March 1937.

MR. F. WARE, F.R.C.V.S., I.V.S., Director, Imperial Veterinary Research Institute, Muktesar, has been appointed, with effect from the afternoon of the

4th March 1937 to officiate as Animal Husbandry Expert, Imperial Council of Agricultural Research, *vice* COL. OLVER, granted leave.

The Indian Central Cotton Committee

In consequence of the vacancy caused by the resignation of MR. J. VONESCH, the Tuticorin Chamber of Commerce has nominated MR. J. HURSCHLER to be a member of the Indian Central Cotton Committee.

The Imperial Agricultural Research Institute

MR. L. D. GALLOWAY, M.A. (Cantab.), Imperial Mycologist, Imperial Agricultural Research Institute, has been granted leave on average pay for two months and five days with effect from the 13th December 1936, with permission to resign his appointment on the expiry of the leave.

DR. M. MITRA, M Sc., Ph.D. (Lond.), D.I.C., F.L S , Assistant Mycologist, Imperial Agricultural Research Institute, has been appointed to hold charge of the current duties of the Imperial Mycologist with effect from the 13th December 1936, in addition to his own duties.

Madras

MR. R. SWAMI RAO, Assistant Director of Agriculture (provisionally substantive), has been appointed to be Assistant Director of Agriculture, permanent, with effect from the 28th June 1935, *vice* Mr. K. GOPALAKRISHNA RAJU promoted as Deputy Director of Agriculture.

Bombay

RAO SAHIB B. P. VAGHOLKAR, Principal Agricultural Officer, Sugarcane Research Scheme, Padegaon, has been granted leave on average pay with effect from the 11th November 1936 to 15th January 1937.

DR. R. D. REGE, Crop Physiologist, Sugarcane Research Scheme, Padegaon, has been appointed to hold charge of the post of the Principal Agricultural Officer, Sugarcane Research Scheme, Padegaon, in addition to his own duties during the absence on leave of RAO SAHIB B. P. VAGHOLKAR.

Bengal

MR. M. CARBERY, M.A., B.Sc., D.S.O., M.C., Assistant Director of Agriculture, has been appointed to act, with effect from the 16th January 1937 until further orders, as Director of Agriculture, Bengal, in addition to his own duties, *vice* Mr. K. MCLEAN, deceased.

Punjab

On return from leave MR. H. R. STEWART, F.R.C.S.I., D.I.C., N.D.A., I.A.S., took over charge of the office of Director of Agriculture, Punjab, Lahore, on the 14th December 1936, relieving KHAN BAHADUR M. FATEH-UD-DIN, M.B.E., B.A., M.R.A.S., A.R.H S., I.A.S., who reverted to his substantive appointment of Deputy Director of Agriculture, Jullundur.

On return from leave DR. P. E. LANDER, M.A. (Cantab.), D.Sc. (Lond.), F.I.C., I.A.S., took over charge of the office of Agricultural Chemist to Government, Punjab, Lyallpur, on the 19th November 1936, relieving DR. DALIP SINGH, who reverted to his substantive appointment of Second Agricultural Chemist, Lyallpur.

KHAN SAHIB MUBARIK ALI SHAH, B.Sc. (Hons.), M.R.C.V.S., has been appointed substantively to the post of Superintendent, Civil Veterinary Department, North-West Frontier Province, with effect from the 17th September 1930.

MR. ABDUL WAHID KHAN, Officiating Deputy Superintendent, Civil Veterinary Department, Rawalpindi, has been appointed Officiating Professor of Animal Husbandry, Punjab Veterinary College, Lahore, with effect from the 12th October 1936, *vice* MR. A. C. AGGARWALA, I.A.R.O., M.R.C.V.S., deputed to the Imperial Council of Agricultural Research.

MR. P. N. NANDA, M.R.C.V.S., Officer-in-charge of the duties of the Superintendent, Civil Veterinary Department, North Punjab, Rawalpindi, is carrying on the duties of Deputy Superintendent, Civil Veterinary Department, Rawalpindi, in addition to his own duties.

MR. GHULAM HUSSAIN, P.V.S., Deputy Superintendent, Civil Veterinary Department, Rohtak, retired from Government Service, with effect from the 16th January 1937.

MR. JAINTI RAM, P.V.S., Deputy Superintendent, Civil Veterinary Department, Gurgaon, is performing the duties of the Deputy Superintendent, Civil Veterinary Department, Rohtak, in addition to his own, pending the appointment of a substitute in place of Mr. Ghulam Hussain.

Bihar

MR. R. T. DAVIS, M.R.C.V.S., I.V.S., Principal of the Bihar Veterinary College, Patna, has been granted leave on average pay for four months and seventeen days and leave on half average pay for eight months and four days, with effect from the 20th May 1937.

Central Provinces

MR. R. J. KALAMKAR, Assistant Agricultural Meteorologist, Meteorological Office, Poona, has been appointed as Assistant Director of Agriculture (on probation) in the Central Provinces Agricultural Service, Class I, with effect from the 1st March 1937, and has been attached to the office of the Director of Agriculture, Central Provinces.

MR. P. D. NAIR, Assistant Director of Agriculture, attached to the office of the Deputy Director of Agriculture, Western Circle, Amraoti, has been appointed as Officiating Deputy Director of Agriculture, Western Circle, *vice* Mr. S. G. MUTKEKAR, on leave.

MR. RAHIM BUX, Assistant Director of Veterinary Services, Jubbulpore division, has been granted leave on average pay for four months combined with leave on half average pay up to the 5th July 1937 preparatory to retirement, with effect from the 24th December 1936.

The name of Dr. E. J. Butler, the first Director of the Imperial Mycological Institute, Kew, is well known to all scientific workers in India on account of his long connection with this country as Imperial Mycologist. We learn that on February 8th Dr. E. J. Butler was the recipient of certain gifts from workers in all parts of Australia. This presentation fund was organised by Dr. W. L. Waterhouse of the University of Sydney. The High Commissioner for the Australian Commonwealth, Mr. S. M. Bruce, made the presentation.

REVIEWS

Rural Welfare in India, 1936. By C. F STRICKLAND, C.I E. (Oxford University Press, London). Price 9*d*.

THIS is a publication of the Indian Village Welfare Association and attempts to review recent work in India. The author has previously published two similar reviews, *viz.*, Review of Rural Welfare Activities in India, 1932, and Progress of Rural Welfare in India, 1934. The present report, like its predecessors, is a tiny paper-covered book of about 50 pages and gives a bird's-eye view of what has been done throughout India, particularly dealing with the developments that have taken place since the Central Government began giving large grants to assist Provincial Governments in carrying out approved schemes of betterment. A perusal of this kindly criticism of the work done in India and the programmes attempted will repay all workers in this field. The following passage may well be regarded as a statement of first principles :—

> " Let it not be thought captious if we recall the four criteria of good organization for rural welfare, which were suggested in previous publications of this Association. To achieve the maximum result in India, a rural welfare organization should aim at (1) permanence ; not depending solely on the enthusiasm of an individual who may not always be present, nor relying on a continuous supply of finance from an external source ; (2) co-ordination ; neither leaving each department to carry out its own function without any reference to other departments busy in the same field, nor overlooking the need for alliance between official and un-official workers ; (3) the employment of trained personnel ; not necessarily experts of high qualification, for an expert can always be called in when required ; but men and women who have been trained in rural ways and in the understanding of village folk ; and (4) minimum cost. There is a possibility that finance from a central government may cause these criteria, if valid (as we believe them to be), to be forgotten. The zealous District Officer *or* missionary *or* ' servant of the people ' under any title should fix his mind on the second year after his own departure ; is he creating anything which will *then* stand upright on its own feet without help from his successor ? If he has inspired enthusiasm in the minds of local people or shown them a

practical benefit, has he trained men who will secure his work against collapse ? Rapid expansion of activity leads to the use of untrained men, for 'here is the money, and there are not enough trained men. But money in the hands of untrained men is useless and harmful. It is not necessary to stress further the dangers of a sudden forward move. The urgent need is for the training of all workers (especially private citizens and employees of un-official societies; servants of government usually possess experience and training in some degree) and the linking up of all efforts, whether of a government, a social institution, or a private group or individual". [W. B.]

The Foods of a Hindu Village of North India. By Charlotte Viall Wiser, Ph.B., M.Sc. (Superintendent, Printing and Stationery, Allahabad, United Provinces, India, 1936). Price Rs. 2-8.

Here is something worth reading. It is characterised by an accuracy, an objectivity and above all a modesty that carry conviction. In Sinclair Lewis' magnificent novel *Martin Arrowsmith* there is given 'The Prayer of the Scientist,' of which the first petition is: "God give me unclouded eyes and freedom from haste". Most fully has this been answered in the case of Mrs. Wiser, whose food studies described in this book are based in the first instance on a residence in the village of Karimpur from 1925 to 1931 (and on continuous work of the same kind ever since).

The description of the village and its people is itself an accurate and fascinating sociological study. So well did the writer know the inhabitants (every one of them apparently) that one gets a living picture of their daily and yearly life, their joys and sorrows, and learns from their rhymes and sayings something of the traditional wisdom that such communities preserve.

Nutrition, however, is the main aim of the study—existing nutrition and its improvement, and in this connection Mrs. Wiser has utilised to the full her contacts with scientific research workers (McCarrison, McCollum, Rose, Sherman and others) in addition to applying her own considerable powers.

In the sixth and last chapter under the dry word 'Conclusions' is set forth very briefly a helpful statement of where we are and where we may be able to arrive. It is also a useful sedative to those who pin their faith to a certain type of propaganda.

Buy the book—it is already a best seller. [W. B.].

All about the Soyabean. By George Douglas Gray. (John Bale, Sons & Danielsson, Ltd., London, 1936.) Price 7*s.* 6*d.* net.

The book provides an interesting account in detail about the soyabean in six informatory chapters. It contains useful information about the origin, description and characteristics of the plant ; the possibilities of its cultivation in England and its utility in general agriculture. The importance of the bean as food and several dietary recipes have been adequately described. The manufacture of soya oil, its edible and industrial uses and everything about the soyabean trade have also been discussed by the author.

The book will be appreciated by all classes of readers who are interested in such problems. [W. S.].

Vegetative Propagation of Tropical and Sub-tropical Fruits. By Fielden, G. St. Cl. and Garner, R. J. (Tech. Comm. No. 7 of the Imperial Bureau of Fruit Production, East Malling, Kent, England, 1936). Pp. 67, bibl. 123, price 2*s.*

This compilation forms the second of a series of articles issued by the Imperial Bureau of Fruit Production on the vegetative propagation of tropical and sub-tropical horticultural crops, the first on citrus having appeared in 1932.

It is based on an examination of existing literature and on the answers to enquiries sent to many workers in the tropics. All the same it would appear that there are a considerable number of sources, particularly in departmental bulletins and agricultural journals, which still remain to be tapped. The section on methods of vegetative propagation (pages seven to seventeen) is very useful and the drawings of various types of grafts, some of which will be new to several readers, are clear and self-explanatory. Those who have good hands for this type of work will find delight in experimenting with the many kinds of grafting and budding here indicated. There are certain tropical substitutes for such things as raffia and grafting wax that might possibly have been mentioned. For example, the fibrous layer inside the stalk petiole of the banana leaf makes very excellent material known as *sopat* in the Bombay-Deccan for tying on buds. Grafting wax is in various places replaced by mixture of mud and cow-dung which is often quite effective. The reviewer would draw special attention to the section of etiological methods on page 10 which is well worth a very extended trial in the Tropics, particularly on account of the necessity of getting stocks of uniform character for really effective horticultural experiments in the future.

The second part of the publication deals with about 100 types of fruit and in each case mentions methods of vegetative propagation that have been found successful or are under experiment. In addition to the ordinary well-known fruit crops, there are also a considerable number of plants which are more or less

wild such as the *Spondias* species, the *Dillenia* species and the *Carissa* species. But these should certainly receive attention as from them may develop really valuable fruit varieties. In this connection special mention should be made of *Zizyphus* to which the last section is devoted. The method of budding found most successful in the Bombay-Deccan has not been mentioned here. This consists in decapitating the stock, removing the bark from the top 2-in. and sliding over it a complete unbroken ring of bark from a similar sized scion containing the bud. *Zizyphus* certainly has considerable possibilities of development. The mango (pages 42-45) naturally comes in for a good deal of attention. Some of the interesting points mentioned are :—

(*p. 43*)—the inducing of a flush of growth by giving one pint of one-ounce-to-the-gallon solution of nitrate of soda about a week before grafting to the stock ;

(*p. 44*)—the possibility of utilising etiolation.

In conclusion, the reviewer would like to point out the desirability in future research work on vegetative propagation of going in some detail into the anatomy of the grafting union somewhat in the manner in which this was done in Sorauer's book on Plant Physiology. [W. B.].

Horticultural Aspects of Woolly Aphis Control together with a Survey of the Literature. BY GREENSLADE, R. M. (Tech. Comm. No. 8 of the Imperial Bureau of Fruit Production, East Malling, Kent, England, 1936). Pp. 88, bibls. 555 (general) and 156 (biologic control), price 2*s.* 6*d.*

THE voluminous literature published during the last hundred years on woolly aphis or American blight and the divergence of opinion there expressed have long demanded examination and critical analysis.

In November 1933 a Memorandum and Questionnaire on the incidence and control of the pest was circulated by the Imperial Bureau of Fruit Production to all the apple growing countries of the world and co-operation invited.

The literature and the replies to the questionnaire have been thoroughly sifted by the present author, who has now for some years at East Malling been testing new seedlings for immunity, investigating control measures in the orchard and studying the causes of immunity or resistance, and is, therefore, in an exceptionally good position for examining the situation. This he does most clearly and concisely for practical horticulturists no less than for fellow investigators in Technical Communication No. 8.

First the insect and its habits, its spread in the orchard, its methods of feeding and its possible alternative hosts are dealt with. Next the bearing of climatic factors, temperature, humidity, wind and sunlight, on its incidence is considered. In many parts of the Empire the normal combination of these factors is propitious

for a heavy attack, whereas in England an increase in temperature and sun and in Rumania an increased rainfall will induce it. Control measures are considered in detail :—(1) Artificial control including spraying, fumigation, tree injection, cultural practice, etc. (2) Natural control by *Aphelinus mali* and other parasites. The varying measure of success achieved in different countries is noted. (3) Control by use of resistant stocks and varieties. A particularly interesting account is given of existing resistant varieties, of the breeding work in progress in England at Merton and East Malling and of the few indications afforded as yet of the possible causes of resistance. Lastly (4) Control by legislation, *e.g.* quarantine measures, etc.

The literature from nearly 300 sources is further dealt with in the two annotated bibliographies which follow. The first, general, contains 555 references, while the second contains 156 references to articles on the biologic control of the pest.

Finally the Memorandum and Questionnaire noted previously are reproduced in full together with a list of persons who replied. This list forms, incidentally, a useful index of workers interested in the subject.

Both to investigators and growers this publication should prove of great reference value.

Live-stock of Southern India. By R. W. LITTLEWOOD. (Higginbothams, Madras ; Government Press, Madras). Price Rs. 4-2-0.

THIS book has recently been published by Mr. R. W. Littlewood, Live-stock Officer, Madras Presidency. A wealth of practical information is given regarding live-stock in South India which should be of great value to those interested on the subject.

NEW BOOKS

On Agriculture and Allied Subjects

Fifty Years of Field Experiments at Woburn. By Sir E. John Russell, D.Sc., F.R.S. and Dr. J. A. Voelcker, C.I.E., M.A. Pp. xvii +392 ; 48 figs. & 146 Tables. (London : Longmans, Green & Co., 1936.) Price 21*s*.

An Introduction to the Scientific Study of the Soil. By Norman M. Comber. Pp. v+206 and 25 figs. (London : Edwin Arnold and Co., 1936.) Price 7*s*. 6*d*.

Soil Erosion and its Control. By Quincy Claude Ayres. Pp. xi+365, 234 figs. (London : McGraw-Hill Publishing Company, Ltd., 1936.) Price 21*s*.

Regional Types of British Agriculture. Edited by J. P. Maxton, M.A., B.Sc., B.Litt. Pp. 318, & Maps. (London : George Allen and Unwin, Ltd., 1936.) Price 12*s*. 6*d*.

Pedalogy. By Jacob S. Joffee. Pp. xvi+575, illustrated. (New Jersey : Rutgers University Press.) Price $5·50.

Vegetative Propagation of Tropical and Sub-tropical Fruits. By Fielden, G. St. Cl. and Garner, R. J. (Tech. Comm. No. 7 of the Imperial Bureau of Fruit Production, East Malling, Kent, England, 1936.) Pp. 67, bibl. 123. Price 2*s*.

Horticultural Aspects of Woolly Aphis Control together with a Survey of the Literature. By Greenslade, R. M. (Tech. Comm. No. 8 of the Imperial Bureau of Fruit Production, East Malling, Kent, England, 1936.) Pp. 88, bibls. 555 (general) and 156 (biologic control). Price 2*s*. 6*d*.

The Hindu Jajmani System—A Socio-economic System inter-relating Members of a Hindu Village Community in Services. By W. H. Wiser, M. A., Ph.D. (Lucknow Publishing House, 1936.)

The Foods of a Hindu Village of North India. By Charlotte Viall Wiser, Ph. B., M.Sc. (Superintendent, Printing and Stationery, Allahabad, U. P., India, 1936.) Price Rs. 2-8.

Practical Animal Husbandry. By William C. Miller, M.R.C.V.S. Second edition. Pp. xi+427 and 180 figs. (Edinburgh : Oliver and Boyd., 1937.) Price 15*s*.

Practical Veterinary Pharmacology, Materia Medica and Therapeutics. By Howard, J. Third edition. Pp. 581, with 33 illustrations, cloth. (Alexander Eger, Chicago, 1936.) Price $6·00.

Milk the Most Perfect Food. By Dr. N. N. Godbole, M.A., B.Sc., Ph.D. (Berlin). (Benares Hindu University, Banares, 1936.) Price Rs. 3.

Recent Publications of the Imperial Agricultural Bureaux

I. Obtainable from the Imperial Bureau of Soil Science, Rothamsted Experimental Station, Harpenden, Herts

Periodical Abstracts

	s.	d.
List of publications and papers on Soil Science published in the Empire Overseas in—		
1933	1	0
1934	1	0
Soil Research in the British Empire published during 1935	1	0
Lists of Publications relating to Soils and Fertilisers—		
Published monthly, per annum, post free	10	0
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Free to recipients, within the British Empire, of "Publications relating to Soils and Fertilisers." Subscription, outside the Empire, per annum	4	0
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" 1934-35	0	6
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Bibliography on Coffee	2	0
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Special Publication—		
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Bibliography of Soil Science, Fertilizers and General Agronomy, 1931-34	25	0

II. Obtainable from the Imperial Bureau of Animal Health, Veterinary Research Laboratory, New Haw, Weybridge, Surrey

Abstracting Journal

	s.	d.
The Veterinary Bulletin—		
1931. Vol. 1. Quarterly (1st Number, April)	7	6
Annual Subscription	20	0
Subsequent Volumes. Monthly (1st Number, January)	5	0
Annual Subscription (postage paid)	40	0

	s.	d
Indexing Publication		
Index Veterinarius.—Four issues a year. First issue April 1933. Annual Subscription (postage paid). Volumes I to III mimeographed, Volume IV onwards printed	100	0

III. OBTAINABLE FROM THE IMPERIAL BUREAU OF ANIMAL NUTRITION, ROWETT RESEARCH INSTITUTE, BUCKSBURN, ABERDEEN

Journal		
Nutrition Abstracts and Reviews. (Issued under the direction of the Imperial Agricultural Bureaux Council, the Medical Research Council and the Reid Library)—		
Subscription per volume of 4 numbers	42	0
Per single number	13	0
Occasional Papers		
Technical Communications—		
6. The Composition of Certain African Foods and Feeding Stuffs	1	0
7. Wheat : Pre-eminence as a Cereal Food, Nutritive Value : Relation to Health and Disease	1	0
Occasional Communications—		
1. The Effect of Climate on the Composition of Pasture Plants	..	

IV. OBTAINABLE FROM THE IMPERIAL BUREAU OF PLANT GENETICS (FOR CROPS OTHER THAN HERBAGE), PLANT BREEDING INSTITUTE, SCHOOL OF AGRICULTURE, CAMBRIDGE

Journal		
Plant Breeding Abstracts—		
Quarterly. Annual Subscription	15	0
Single copy	5	0
Occasional Papers		
Indexes to Plant Breeding Abstracts—		
Subject Index to Vols. I to V of Plant Breeding Abstracts	5	0
Supplements to Plant Breeding Abstracts—		
Summary of Reports received from Countries exclusive of the British Empire, 1928-31. Supplement I	2	6
Summary of Reports received from Stations in the British Empire, 1932-35. Supplement II	5	0
Technical Communications—		
Vernalization and Phasic Development of Plants (Joint Publication of the Imperial Bureaux of Plant Genetics)	10	0
Bibliographical Monographs—		
Breeding Resistant Varieties, 1930-33 (Supplement)	2	0
The Experimental Production of Haploids and Polyploids	5	0

V. Obtainable from the Imperial Bureau of Plant Genetics (Herbage Plants), Welsh Plant Breeding Station, Agricultural Buildings, Alexandra Road, Aberystwyth, Wales

	Journals	s.	d.
Herbage Abstracts—			
Quarterly. Annual Subscription		15	0
Single number		5	0

Herbage Reviews—

Subscription is at present—Vol. 1 (1933), Vol. 2 (1934), Vol. 3 (1935), Vol. 4 (1936)—included in that to Herbage Abstracts.

Occasional Papers

Bulletins—

15. Grassland and Forage Crops in Thuringia, Czechoslovakia and Hungary, August, 1934	3	6
17. Vernalization and Phasic Development of Plants. December, 1935. (Joint publication of the Imperial Bureaux of Plant Genetics)	10	0

VI. Obtainable from the Imperial Bureau of Fruit Production, East Malling Research Station, East Malling, Kent

Journal

Horticultural Abstracts—

A quarterly abstract publication of current horticultural literature—

Annual Subscription	15	0
Single copy	4	0

Technical Communications

6. The Nutrition and Manuring of Soft Fruits, 1936. T. Wallace	2	0
7. Vegetative Propagation of Tropical and Sub-tropical Fruits, 1936. J. St. Clair Feilden and R. J. Garner	2	0

Occasional Papers

3. Annotated Bibliography on Bitter-Pit, 1934	1	6

Other Publications—

Index to Volumes I-X of the *Journal of Pomology and Horticultural Science*, 1933. Compiled by Bureau, published by the Editors of the *Journal of Pomology and Horticultural Science*. Available from the Bureau	5	0
Old and New standpoints on senile degeneration, 1931. By A. P. C. Bijhouwer	0	6

VII. Obtainable from the Imperial Bureau of Animal Genetics, Institute of Animal Genetics, University of Edinburgh, King's Buildings, West Mains Road, Edinburgh

Journal

Animal Breeding Abstracts (Quarterly), commencing April, 1933. Annual Subscription	15	0

Occasional Papers

	s.	d.
The Technique of Artificial Insemination, 1933	2	6
Bibliography of the works of J. C. Ewart (free to subscribers of Animal Breeding Abstracts, Vol. 1), 1934	0	6
Animal Breeding in the British Empire. A Survey of Research and Experiment, 1934	2	0

VIII. Obtainable from the Imperial Bureau of Agricultural Parasitology, Institute of Agricultural Parasitology, Winches Farm Drive, Hatfield Road, St. Albans, Herts

Journal

Bibliography of Helminthology. For the year 1933—

Library Edition, bound in cloth	10	6
Stiff paper cover only	8	0
Helminthological Abstracts. Issued in five or six parts per volume, each volume covering the literature of a single year. Subscription per volume, payable in advance	30	0
Completed volumes bound in cloth	32	0

Occasional Papers

(*g*) The Pathology and Aetiology of Plant Lesions caused by Parasitic Nematodes. By T. Goodey. 34 pp.	5	0
(*h*) The Bearing of the Physiology of Parasitic Nematodes on their Treatment and Control. By A. Lapage. 21 pp.	3	0

Notes and Memoranda—

11. Recent Developments in the Control of *Heterodera marioni*, 6 pp. .	1	6

Publications issued by the Imperial Institute of Entomology, 41 Queen's Gate, London, S. W. 7

Bulletin of Entomological Research—

Published quarterly and containing original articles on Economic Entomology. Issued post free.

Annual subscription (payable in advance) 30 0

Review of Applied Entomology—

Consisting of abstracts or reviews of all current literature on Economic Entomology throughout the world. Published monthly in two series—

Series 'A' dealing with insect and other arthroped pests of cultivated plants, forest trees and stored products of animal and vegetable origin.

Series 'B' dealing with insects, ticks, etc., conveying disease or otherwise injurious to man and animals. Issued post free.

	Series 'A'	Series 'B'
Annual subscription (payable in advance)	30*s.*	15*s.*
Vol. XXIII (1935)	42*s*	21*s.*

	s. d.
Zoological Record—Part Insecta—	
Published annually about July in each year and containing as complete a record as possible of the literature of the previous year, chiefly from the systematic standpoint.	
Annual subscription (including postage)	15 6
Report of the Fourth Imperial Entomological Conference, 19th—27th September, 1935	4 0

PUBLICATIONS OBTAINABLE FROM THE IMPERIAL MYCOLOGY INSTITUTE, KEW, SURREY

Journal

Review of Applied Mycology –	
Annual subscription, 12 monthly parts, with title page and index (post free)	21 0
Single part	2 0
Title page and index	3 0
Report on the Third Imperial Mycological Conference, 1934 . . .	2 0

List of Agricultural Publications in India from 1st August 1936 to 31st January 1937

Title	Author	Where published
GENERAL AGRICULTURE		
Agriculture and Livestock in India, Vol. VI, parts 5 and 6 and Vol. VII, part 1. Annual subscription Rs. 6 or 9*s*. 9*d*. (A bi-monthly journal of agriculture and animal husbandry for the general reader interested in agriculture or live-stock in India or the Tropics)	Issued under the authority of the Imperial Council of Agricultural Research	Manager of Publications, Delhi
The Madras Agricultural Journal. Monthly. Annual subscription Rs. 4	K. Ramiah (Editor). Published by the M. A. S. Union, Agricultural Research Institute, Coimbatore	The Secretary, M. A. S. Union, Agricultural College, Lawley Road, P. O.
The Journal of the Trichinopoly District Agricultural Association (English and Tamil). Quarterly. Annual subscription Re. 1-8-0 for non-members, free for members	Issued by the Trichinopoly District Agricultural Association, Teppakulam Post	The Secretary, The Trichinopoly District Agricultural Association, Teppakulam Post
The Journal of the Mysore Agricultural and Experimental Union (English). Quarterly. Price As. 12 per copy	B. Narasimha Iyengar (Chief Editor)	The Secretary, The Mysore Agricultural and Experimental Union, Seshadri Road, Bangalore
The Journal of the Mysore Agricultural and Experimental Union (Kannada). Monthly. Price As. 4 per copy	K. Bhima Rao (Editor)	Ditto
The Poona Agricultural College Magazine. Quarterly. Annual subscription Rs. 2-8-0	V. G. Deshpande and S. M. Rao (Editors)	The Editor, *Poona Agricultural College Magazine*, Poona
Setki Setkari (Marathi). Monthly. Annual subscription Re. 1-3-0	Vasudev Ganesh Pande	The Editor, *Setki Setkari*, Agricultural College, Poona

GENERAL AGRICULTURE—*contd.*

Title	Author	Where published
The Planters' Journal and Agriculturist. Fortnightly. Annual subscription Rs. 10 or 16*s.*	Theo H. Thorne (Editor)	The Manager, *The Planters' Journal and Agriculturist*, 13, Ezra Mansions, Calcutta
Krishi-Sampad (Bengali). Monthly. Annual subscription Rs. 3	N. K. Ghosh (Editor)	The Manager, Krishi Sampada Office, Dacca
Mufidul Mazarain (Urdu)	Issued by the Department of Agriculture, United Provinces	Government Printing and Stationery, United Provinces, Allahabad
Kisan Upkarak (Hindi)	Ditto	Ditto
The Allahabad Farmer. Bi-monthly. Annual subscription in India Rs. 2	B. M. Pugh (Editor). Published by the Agricultural Institute, Allahabad	The Allahabad Agricultural Institute, United Provinces (American Presbyterian Mission), Allahabad
Seasonal Notes. Price As. 4 per copy	Issued by the Department of Agriculture, Punjab	Government Printing, Punjab, Lahore
The Nagpur Agricultural College Magazine. Quarterly. Annual subscription Rs. 3	Published by P. D. Nair, Agricultural College, Nagpur	The Editor, *The Nagpur Agricultural College Magazine*, College of Agriculture, Nagpur
Kisan (Hindi). Quarterly. Annual subscription Rs. 2, As. 8 per copy	Issued by the Agricultural Association, Bihar and Orissa	B. N. Sarcar, Senior Marketing Officer and Editor, Kisan, Patna
Agriculture and Animal Husbandry in India, 1933-34 and 1934-35. Part I—Crop Production. Price Rs. 4-14-0 or 8*s.*	Issued under the authority of the Imperial Council of Agricultural Research	Manager of Publications, Delhi
Indian Central Cotton Committee—Its Objects, Activities and Achievements (Pamphlet in Gujerati, Marathi, Hindi and Urdu)	Secretary, Indian Central Cotton Committee	Indian Central Cotton Committee, Bombay

GENERAL AGRICULTURE—*contd.*

Title	Author	Where published
Indian Central Cotton Committee —A Brief Account of Its Objects and Achievements (Pamphlet in English, Urdu and Hindi)	Secretary, Indian Central Cotton Committee	Indian Central Cotton Committee, Bombay
Indian Central Cotton Committee —Technological Laboratory, Matunga (Leaflet in English, Hindi and Urdu)	Ditto	Ditto
Descriptive Note on Improved Strains from Important Varieties of Paddy evolved at the Agricultural Research Station, Maruteru (Telugu). Leaflet No. 72 of the Department of Agriculture, Madras	K. Ramiah	Government Press, Madras
Villagers' Calendar for 1936-37 (Malayalam)	Issued by the Department of Agriculture, Madras	Ditto
Villagers' Calendar for 1937 (English)	Ditto	Ditto
Annual Report of the Department of Agriculture, Bengal for 1935-36	Issued by the Department of Agriculture, Bengal	Bengal Government Press, Alipore, Bengal
Talk on Cultivation (Slogans). Leaflet No. 10 of 1936 of the Department of Agriculture, Bengal	Ditto	Ditto
Jute Cultivation and Fibre Production. Leaflet No. 11 of 1936 of the Department of Agriculture, Bengal	Ditto	Ditto
An Investigation on the Methods of Preparation and Standardization of Tomato Ketchup. Bulletin of the Department of Agriculture, Punjab. Price As. 4	Issued by the Department of Agriculture, Punjab	Government Printing, Punjab, Lahore

GENERAL AGRICULTURE—*contd.*

Title	Author	Where published
Betel Nut in Burma. Agricultural Survey No. 25 of the Department of Agriculture, Burma	Issued by the Department of Agriculture, Burma	Government Printing and Stationery, Burma, Rangoon
The Cultivation of Betel Nut. Cultivators' Leaflet No. 80 of the Department of Agriculture, Burma	Ditto	Ditto
Layout and Anti-erosion Measures in the Dry Zone (Burmese). Cultivators' Leaflet No. 81 of the Department of Agriculture, Burma	Ditto	Ditto
Onion Cultivation in the Northern Circle. Bulletin No. 31 of the Department of Agriculture, Burma	Ditto	Ditto
Market Surveys of Burma Crops. Bulletin No. 32 of the Department of Agriculture, Burma	Ditto	Ditto
Annual Report of the Department of Agriculture, Bihar, 1935-36	Issued by the Department of Agriculture, Bihar	Government Press, Bihar, Gulzarbagh
Annual Report on Experimental Farms in Bihar, 1935-36	Ditto	Ditto
Cultivation of Berseem. Bulletin No. 4 of 1936 of the Department of Agriculture, Bihar	Ditto	Ditto
The Role of Seed Unions in Village Uplift (English and Hindi). Leaflet No. 9 of 1936 of the Department of Agriculture, Central Provinces	Issued by the Department of Agriculture, Central Provinces	Government Printing, Central Provinces, Nagpur
Report on the Agricultural College, Nagpur, for the Year ending the 31st March 1936	Issued by the Department of Agriculture, Central Provinces	Government Printing, Central Provinces, Nagpur

Title	Author	Where published
GENERAL AGRICULTURE—*contd.*		
Report on the Engineering Section, Agricultural College, Nagpur, for the Year ending the 31st March 1936	Issued by the Department of Agrculture, Central Provinces	Government Printing Central Provinces, Nagpur
Wheat Cultivation in Chhattisgarh and how to Improve it (English and Hindi). Leaflet No. 7 of 1936 of the Department of Agriculture, Central Provinces	Ditto	Ditto
Protection of Crops against Damage from Frost (English and Hindi). Leaflet No. 8 of 1936 of the Department of Agriculture, Central Provinces	Ditto	Ditto
Annual Report of the Department of Agriculture in Sind, 1935-36	Issued by the Department of Agriculture, Sind	The Daily Gazette Press, Ltd., Karachi
Instructions for the Cultivation of *Aleurites fordii* Tung Oil in Chota Nagpur (English and Hindi)	Dorothy Norris	Indian Lac Research Institute, Namkum, Ranchi.
Memoranda on the History, Activities and Policy of the United Planters' Association, South India. Tea Scientific Department	Issued by the United Planters' Association of South India	United Planters' Association for South India, Glenview, Coonoor, Nilgiris
Annual Report on the working of the Department of Agriculture, Hyderabad-Deccan for 1933-34	Issued by the Department of Agriculture, Hyderabad	Government Central Press, Hyderabad-Deccan
Annual Experimental and Research Report of Hyderabad for 1932-33.	Ditto	Ditto
Drama of Premi Kisan. Leaflet No. 18 of the Department of Agriculture, Hyderabad.	Ditto	Ditto
Ploughing	N. Narayanan Tampi	Government Press, Travancore

GENERAL AGRICULTURE—*concld.*

Title	Author	Where published
Annual Administration Report of the Department of Agriculture, Mysore State, for the Year 1934-35. Price Re. 1-8-0	Issued by the Department of Agriculture, Mysore	Government Press, Bangalore
Growing Trees for Timber, Fuel and Green Manure	Issued by the Department of Agriculture, Cochin	Cochin Government Press, Ernaculam
A Kind of Poison found in the Leaf of Rubber	Ditto	Ditto

AGRICULTURAL STATISTICS

Title	Author	Where published
Supply and Distribution of the Various Types of Indian Cotton during the Season of 1934-35. Statistical Bulletin No. 5 (1934-35). Price As. 8	Secretary, Indian Central Cotton Committee	Indian Central Cotton Committee, Bombay
Stocks of Indian Raw Cotton held in India by the Mills and the Trade on 31st August, 1936. Statistical Leaflet No. 2. Third Issue (1935-36)	Ditto	Ditto
Receipts at Mills in India of Raw Cotton Classified by Varieties (1935-36 Season). Statistical Leaflet No. 3. Third Issue (1935-36). Price 0-1-0	Ditto	Ditto
Exports by Seas of Indian Raw Cotton Classified by Varieties (1935-36 Season). Statistical Leaflet No. 4. Third Issue (1935-36). Price 0-1-0	Ditto	Ditto
Season and Crop Report for the Year ending 30th June 1936. Price Rs. 3-8-0 per copy	Issued by the Department of Agriculture, Punjab, Lahore	Government Printing, Punjab, Lahore
Season and Crop Report, Sind, 1935-36	Issued by the Department of Agriculture, Sind	The Daily Gazette Press, Ltd., Karachi

Title	Author	Where published
SUGARCANE		
Notes on Sugarcane Cultivation in Bengal. Leaflet No. 9 of 1936 of the Department of Agriculture, Bengal	Issued by the Department of Agriculture, Bengal	Bengal Government Press, Alipore, Bengal
Cultivation of Sugarcane in Chota Nagpur. Bulletin No. 5 of 1936 of the Department of Agriculture, Bihar	Issued by the Department of Agriculture, Bihar	Government Press, Bihar, Gulzarbagh
Manuring of Sugarcane in Bihar by Agricultural Chemist. Leaflet No. 3 of 1936 of the Department of Agriculture, Bihar	Ditto	Ditto
A Brief Note on Sugarcane Research Work done by the Department during the last 4 Years and Its Significance to the Sugarcane Industry in Bihar. Leaflet No. 4 of 1936 of the Department of Agriculture, Bihar	Ditto	Ditto
Some Hints to Sugarcane Cultivators	V. Narayanan Nair	Government Press, Travancore
COTTON TECHNOLOGY		
The Effect of Raising the Middle Roller and some other Factors on the Yarn Strength of Sindhi Cotton. Technological Bulletin No. 34	Nazir Ahmad	Indian Central Cotton Committee, Bombay
Technological Reports on Trade Varieties of Indian Cottons, 1936. Technological Bulletin No. 35	Ditto	Ditto
Spinning Tests on Mixtures of Staple Fibres and Indian Cottons. Technological Bulletin No. 36	Ditto	Ditto
Spinning Test Report (No. 754) on Samples of Farm Westerns Cotton, 1935-36. Technological Circular No. 253. Price As. 4	Issued by the Director, Technological Laboratory, Indian Central Cotton Committee, Bombay	Ditto

COTTON TECHNOLOGY—*contd.*

Title	Author	Where published
Spinning Test Report (No. 755) on Samples of Upland Cotton, 1935-36. Technological Circular No. 254. Price As. 4	Issued by the Director, Technological Laboratory, Indian Central Cotton Committee, Bombay	Indian Central Cotton Committee, Bombay
Spinning Test Report (No. 756) on Samples of Kadi-Viramgam Cotton, 1935-36. Technological Circular No. 255. Price As. 4	Ditto	Ditto
Spinning Test Report (No. 758) on Samples of Bijapur Cotton, 1935-36. Technological Circular No. 256. Price As. 4	Ditto	Ditto
Spinning Test Report (No. 758) on Samples of Kalagin Cotton, 1935-36. Technological Circular No. 257. Price As. 4	Ditto	Ditto
Spinning Test Report (No. 778) on Samples of Bagalkot Cotton, 1935-36. Technological Circular No. 258. Price As. 4	Ditto	Ditto
Spinning Test Report (No. 779) on Samples of Cambodia Cotton, 1935-36. Technological Circular No. 259. Price As. 4	Ditto	Ditto
Spinning Test Report (No. 781) on Samples of Tinnevelly Cotton, 1935-36. Technological Circular No. 260. Price As. 4	Ditto	Ditto
Spinning Test Report (No. 782) on Samples of Karunganni Cotton, 1935-36. Technological Circular No. 261. Price As. 4	Ditto	Ditto
Spinning Test Report (No. 784) on Samples of A. R. Jinja Cotton, 1935-36. Technological Circular No. 262. Price As. 4	Ditto	Ditto

Title	Author	Where published
COTTON TECHNOLOGY—*contd.*		
Spinning Test Report (No. 786) on Samples of A. R. Busoga Cotton, 1935-36. Technological Circular No. 263. Price As. 4	Issued by the Director, Technological Laboratory, Indian Central Cotton Committee, Bombay	Indian Central Cotton Committee, Bombay
Spinning Test Report (No. 789) on Samples of A. R. Kampala Cotton, 1935-36. Technological Circular No. 264. Price As. 4	Ditto	Ditto
Spinning Test Report (No. 791) on Samples of Western Javeria Cotton, 1935-36. Technological Circular No. 265. Price As. 4	Ditto	Ditto
Spinning Test Report (No. 795) on Samples of Kumpta Cotton, 1935-36. Technological Circular No. 266. Price As. 4	Ditto	Ditto
Technological Report on Verum 262 (Akola), 1936-37. Technological Circular No. 267. Price As. 4	Ditto	Ditto
Technological Report on V. 434 (Akola), 1936-37. Technological Circular No. 268. Price As. 4	Ditto	Ditto
Technological Report on Umri Bani Cotton, 1936-37. Technological Circular No. 269. Price As. 4	Ditto	Ditto
Spinning Test Report (No. 798) on Samples of Bengals Cotton, 1936-37. Technological Circular No. 270. Price As. 4	Ditto	Ditto
Spinning Test Report (No. 799) on Samples of Khandesh Cotton, 1936-37. Technological Circular No. 271. Price As. 4	Ditto	Ditto

Title	Author	Where published
COTTON TECHNOLOGY—*concld.*		
Spinning Test Report (No. 801) on Samples of Ujjain Cotton, 1936-37. Technological Circular No. 272. Price As. 4	Issued by the Director, Technological Laboratory, Indian Central Cotton Committee, Bombay	Indian Central Cotton Committee, Bombay
Spinning Test Report (No. 802) on Samples of Ujjain Cotton, 1936-37. Technological Circular No. 273. Price As. 4	Ditto	Ditto
Spinning Test Report (No. 805) on Samples of Mogali Cotton, 1936-37. Technological Circular No. 274. Price As. 4	Ditto	Ditto
Technological Report on Verum 262 (Nagpur), 1936-37. Technological Circular No. 275. Price As. 4	Ditto	Ditto
FRUITS		
Burma Fruits and their Cultivation. Bulletin No. 30 of the Department of Agriculture, Burma	Issued by the Department of Agriculture, Burma	Government Printing and Stationery, Burma, Rangoon.
Manuring of Oranges (Reprint). Leaflet	Issued by the Department of Agriculture, Central Provinces	Government Printing, Central Provinces, Nagpur
Cultivation of Pomegranate (Urdu). Leaflet No. 5 of the Department of Agriculture, Hyderabad	Issued by the Department of Agriculture, Hyderabad	Government Central Press, Hyderabad, Deccan
Budding of Lime Plants	P. K. Krishna Pillai	Government Press, Travancore
Banana Cultivation	P. O. Abraham	Ditto
Mango Grafts and other Fruit Plants. (Reprint of leaflet published in 1931)	Issued by the Department of Agriculture, Cochin	Cochin Government Press, Ernaculam

Title	Author	Where published
LAC		
The Shellac Industry	Issued by the Director, Indian Lac Research Institute, Namkum, Ranchi	Indian Lac Research Institute, Namkum, Ranchi
Some Simple Methods of Reducing the Damage done by Insect Enemies to the Lac Crops (English, Hindi, Uriya and Bengali). Bulletin No. 23.	P. M. Glover	Ditto
The Use of *Schleichera trijuga* (*Kusum*) in Lac Cultivation. Bulletin No. 24. Price 0-0-9	Dorothy Norris	Ditto
Use of the Quinhydrone and Antimony Electrodes for Potentiometric Titrations of Resin Solution. Bulletin No. 25. Price As. 3	Narasimha Murty and Harold Weinberger with Wm. Howlett Gardner	Ditto
AGRICULTURAL SCIENCE		
General		
The Indian Journal of Agricultural Science, Vol. VI, parts 4-6. Annual subscription Rs. 15 or 24*s*. (Original scientific work in the various branches of science applied to agriculture, formerly published in the Memoirs of the Imperial Department of Agriculture in India is now published in the *Indian Journal of Agricultural Science*	Issued under the authority of the Imperial Council of Agricultural Research	Manager of Publications, Delhi
Tables of Standard Errors of Mendelian Ratios. Miscellaneous Bulletin No. 11 of the Imperial Council of Agricultural Research	Swarn Singh Purewal and P. Krishna Rao	Ditto
Two New Statistical Tables based upon Fisher's '*t*'. Miscellaneous Bulletin No. 13 of the Imperial Council of Agricultural Research	M. Vaidyanathan . .	Ditto

AGRICULTURAL SCIENCE—*contd.*

General—*contd.*

Title	Author	Where published
Scientific Reports of the Imperial Institute of Agricultural Research, Pusa, for the Year 1934-35 including the Reports of the Dairy Expert, Physiological Chemist and Sugarcane Expert	Issued by the Director, Imperial Institute of Agricultural Research, Pusa	Manager of Publications, Delhi.
Scientific Report of the Sugarcane Research Station, Bihar and Orissa, for the Year ending 31st March 1935. Bulletin No. 2 of 1936 of the Department of Agriculture, Bihar and Orissa	Issued by the Department of Agriculture, Bihar	Government Press, Bihar, Gulzarbagh
Scientific Report of the Sugarcane Research Station, Bihar and Orissa, for the Year ending 31st March 1936. Bulletin No. 3 of 1936 of the Department of Agriculture, Bihar and Orissa	Ditto	Ditto

Botany

Title	Author	Where published
List of Publications on the Botany of Indian Crops, Part II, for the Period 1928-29. Miscellaneous Bulletin No. 12 of the Imperial Council of Agricultural Research. Price Rs. 3-6 or 5*s*. 9*d*.	R. D. Bose	Manager of Publications, Delhi
Report on the Botanical Section, Agricultural College, Nagpur, for the Year ending 31st March 1936	Issued by the Department of Agriculture, Central Provinces	Government Printing, Central Provinces, Nagpur

Chemistry and Physical Chemistry

Title	Author	Where published
The Use of Manures in the Madras Presidency—Pamphlet No. 9 of the Department of Agriculture, Madras	P. Venkataramiah	Government Press, Madras

AGRICULTURAL SCIENCE—*contd.*

Chemistry and Physical Chemistry—*contd.*

Title	Author	Where published
Mineral Constituents of Food Grains, Vegetables and Cattle Feeds of Western India. Bulletin No. 179 of 1936 of the Department of Agriculture, Bombay Presidency. Price one anna	D. L. Sahsrabuddhe	Government Central Press, Bombay
Report on Manurial Experiments carried out in Burma by the Agricultural Department from 1912-13 to 1930-31. Bulletin No. 29 of the Department of Agriculture, Burma	Issued by the Department of Agriculture, Burma	Government Printing and Stationery, Burma, Rangoon
Report on the Chemical Section, Agricultural College, Nagpur, for the Year ending 31st March 1936	Issued by the Department of Agriculture, Central Provinces	Government Printing, Central Provinces, Nagpur
Green Manuring	Issued by the Department of Agriculture, Cochin	Cochin Government Press, Ernaculam

Entomology

Title	Author	Where published
The Spotted Boll-worms of Cotton in South Gujarat. Monograph No. 10 of the Imperial Council of Agricultural Research. Price Rs. 5-14 or 9*s*. 6*d*.	B. P. Despande and N. T. Nadkarny	Manager of Publications, Delhi
Pink Boll-worm Pest of Cotton and how to Control it	Secretary, Indian Central Cotton Committee	Indian Central Cotton Committee, Bombay,
The Pink Boll-worm of Cotton and its Control. Leaflet No. 10 of the Department of Agriculture, Central Provinces (English, Hindi and Marathi)	Issued by the Department of Agriculture, Central Provinces.	Government Printing, Central Provinces, Nagpur
Report on the Entomological Research, Agricultural College, Nagpur, for the Year ending 31st March 1936	Ditto	Ditto

AGRICULTURAL SCIENCE—*concld.*

ENTOMOLOGY—*contd.*

Title	Author	Where published
How to send Insect Specimens for Identification. Leaflet No. 20 of the Department of Agriculture, Hyderabad	Issued by the Department of Agriculture, Hyderabad	Government Central Press, Hyderabad-Deccan
Some Plant Pests found in Flower Gardens	Issued by the Department of Agriculture, Cochin	Cochin Government Press. Ernakulam
Two Types of Paddy Grass Hoppers	Ditto	Ditto

PLANT DISEASES

Title	Author	Where published
Diseases of Sugarcane and Methods for their Control. Miscellaneous Bulletin No. 10 of the Imperial Council of Agricultural Research. Price Rs. 1-14 or 3s. 3*d*.	L. S. Subrahmaniam .	Manager of Publications, Delhi
Leaf Curl Disease of Chillies. Leaflet No. 73 of the Department of Agriculture, Madras	M. C. Cherian	Government Press, Madras
Report on the Mycological Research, Agricultural College, Nagpur, for the Year ending 31st March 1936	Issued by the Department of Agriculture, Central Provinces	Government Printing, Central Provinces, Nagpur
Pink Disease. United Planters Association, Southern India, Tea Scientific Department Bulletin No. 10	M. K. Subba Rao	United Planters Association of Southern India, Glenview, Conoor, Nilgiris
Cocoanut Leaf Disease in Cochin Kanayannur Taluk	Issued by the Department of Agriculture, Cochin	Cochin Government Press, Ernakulam

AGRICULTURAL SCIENCE—*contd.*

Chemistry and Physical Chemistry—*contd.*

Title	Author	Where published
Mineral Constituents of Food Grains, Vegetables and Cattle Feeds of Western India. Bulletin No. 179 of 1936 of the Department of Agriculture, Bombay Presidency. Price one anna	D. L. Sahsrabuddhe	Government Central Press, Bombay
Report on Manurial Experiments carried out in Burma by the Agricultural Department from 1912-13 to 1930-31. Bulletin No. 29 of the Department of Agriculture, Burma	Issued by the Department of Agriculture, Burma	Government Printing and Stationery, Burma, Rangoon
Report on the Chemical Section, Agricultural College, Nagpur, for the Year ending 31st March 1936	Issued by the Department of Agriculture, Central Provinces	Government Printing, Central Provinces, Nagpur
Green Manuring	Issued by the Department of Agriculture, Cochin	Cochin Government Press, Ernaculam
	Entomology	
The Spotted Boll-worms of Cotton in South Gujarat. Monograph No. 10 of the Imperial Council of Agricultural Research. Price Rs. 5-14 or 9*s*. 6*d*.	B. P. Despande and N. T. Nadkarny	Manager of Publications, Delhi
Pink Boll-worm Pest of Cotton and how to Control it	Secretary, Indian Central Cotton Committee	Indian Central Cotton Committee, Bombay,
The Pink Boll-worm of Cotton and its Control. Leaflet No. 10 of the Department of Agriculture, Central Provinces (English, Hindi and Marathi)	Issued by the Department of Agriculture, Central Provinces.	Government Printing, Central Provinces, Nagpur
Report on the Entomological Research, Agricultural College, Nagpur, for the Year ending 31st March 1936	Ditto	Ditto

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Title	Author	Where published
VETERINARY SCIENCE AND ANIMAL HUSBANDRY		
Agriculture and Live-stock in India, Vol. VI, parts 5 and 6; Vol. VII, part 1. Annual subscription Rs. 6 or 9*s*. 9*d*. (A bi-monthly journal of agriculture and animal husbandry for the general reader interested in agriculture or live-stock in India or the Tropics).	Issued under the authority of the Imperial Council of Agricultural Research	Manager of Publications, Delhi
The Indian Journal of Veterinary Science and Animal Husbandry, Vol. VI, parts 3 and 4. Annual subscription Rs. 6 or 9*s*. 9*d*. (A quarterly journal for the publication of scientific matter relating to the health, nutrition and breeding of live-stock).	Ditto	Ditto
The Indian Veterinary Journal (The Journal of the All-India Veterinary Association). Quarterly. Annual subscription Rs. 4 or 6*s*. 6*d*. for members and Rs. 8 or 10*s*. for others.	P. Srinivasa Rao (Editor)	The Editor, *The Indian Veterinary Journal*, 26 Wallajah Road, Madras
The United Provinces Veterinary Magazine (English and Urdu). Monthly. Issued free to members of the United Provinces Veterinary Association	Issued by the United Provinces Veterinary Association	The Editor, *The United Provinces Veterinary Magazine*, Moradabad
The Punjab Veterinary Journal	Issued by the Punjab Veterinary Association	The Editor, *The Punjab Veterinary Journal*, Lahore
The Central Provinces Veterinary Journal. Quarterly	Issued by the Central Provinces Veterinary Association	The Honorary Secretary, Central Provinces Veterinary Association, Nagpur
Agriculture and Animal Husbandry in India, 1933-34 and 1934-35. Part II—Animal Husbandry. Price Re. 1 or 1*s*. 9*d*.	Issued under the authority of the Imperial Council of Agricultural Research	Manager of Publications, Delhi

VETERINARY SCIENCE AND ANIMAL HUSBANDRY—*contd.*

Title	Author	Where published
Annual Report of the Imperial Institute of Veterinary Research, Muktesar, for the Year ending 31st March 1936	Issued by the Director, Imperial Institute of Veterinary Research, Muktesar	Manager of Publications, Delhi.
Cattle Breeding (Tamil, Telugu, Kanarese and Malayalam already published in English). Leaflet No. 70	R. W. Littlewood	Government Press, Madras.
Breeding Bulls and their Management (Tamil, Telugu and Kanarese already published in English). Leaflet No. 71.	Ditto	Ditto
Conditions to be fulfilled for the Grant of Premium for Breeding Bulls maintained by Private Bodies (Reprinted)	Issued by the Department of Agriculture, Madras	Ditto
Some Advantages of Poultry Keeping (Reprinted). (Tamil, Telugu, Kanarese and Malayalam). Leaflet No. 54 of the Department of Agriculture, Madras	R. W. Littlewood	Ditto
Natural Incubation of Poultry (Reprinted). (English, Kanarese and Malayalam). Leaflet No. 55 of the Department of Agriculture, Madras	Ditto	Ditto
Brooding and Rearing of Chicks (Reprinted). Leaflet No. 56 of the Department of Agriculture, Madras	Ditto	Ditto
Housing of Poultry (Reprinted). Leaflet No. 57 of the Department of Agriculture, Madras	Ditto	Ditto
Book on Live-stock of Southern India	Ditto	Ditto

Title	Author	Where published

VETERINARY SCIENCE AND ANIMAL HUSBANDRY—*contd.*

Title	Author	Where published
Note of the Possibilities of Hormone Treatment for Slow Breeding in Cows and Bulls	P. J. Kerr	Bengal Government Press, Alipore, Bengal
A Review of the Position in Regard to the Incidence and Control of Diseases of Sheep and Goats that are Important from the Point of View of Export of these Animals from India	Balwant Singh	Ditto
Better Cattle. Leaflet No. 8 of 1936 of the Department of Agriculture, Bengal	Issued by the Department of Agriculture, Bengal	Ditto
List of Horse and Cattle Fairs and Shows in the Punjab and Punjab States, for the Fasli Year 1936-37	Issued by the Director, Veterinary Services, Punjab	Government Printing, Punjab, Lahore
Annual Report of the Civil Veterinary Department, Punjab, for the Year 1935-36	Ditto	Ditto
Live-stock at the Government Cattle Farm, Hissar. Veterinary Bulletin No. 7 of 1936 of the Department of Veterinary Services, Punjab	Ditto	Ditto
Review of the Warble Fly Pest in India. Veterinary Bulletin No. 9 of 1936 of the Department of Veterinary Services, Punjab	Ditto	Ditto
Mange in Sheep. Veterinary Leaflet No. 5 of the Department of Veterinary Services, Punjab	Ditto	Ditto
Report on the Maharajbagh Menageries together with the External Work of the Veterinary Inspector attached to the Agricultural College, Nagpur, for the Year ending 31st March 1936	Issued by the Department of Agriculture, Central Provinces	Government Printing, Central Provinces, Nagpur

VETERINARY SCIENCE AND ANIMAL HUSBANDRY—*concld.*

Title	Author	Where published
Annual Report of the Civil Veterinary Department, Assam, for the Year ending 1935-36	Issued by the Civil Veterinary Department, Assam	Government Press, Assam, Shillong
Poultry Survey Report (Urdu). Bulletin No. 7 of the Depart- of Agriculture, Hyderabad	Issued by the Department of Agriculture, Hyderabad	Government Central Press, Hyderabad-Deccan
Brief Instructions for the Guidance of Lay Persons regarding Improvement of Animal Industry, chiefly Cattle, Sheep and Poultry. Circular No. 56 of the Department of Agriculture, Mysore	A. A. Monteiro	Government Press, Bangalore
Cattle Shed and its Premises. Issued by the Department of Agriculture, Travancore	K. Krishna Pillai	Government Press, Travancore

PUBLICATIONS OF THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, INDIA

1. Agriculture and Live-stock in India

A bi-monthly Journal of Agriculture and Animal Husbandry for the general reader interested in Agriculture or Live-stock in India or the Tropics. (Established 1931. Published in January, March, May, July, September and November. Prepayable subscription Rs. 6 or *9s. 9d.* per annum inclusive of Indian postage. Price per part Rs. 2 or *3s. 6d.* inclusive of Indian postage.) Volumes I to VI complete are available.

2. The Indian Journal of Agricultural Science

A bi-monthly Scientific Journal of Agriculture and the Allied Sciences, mainly devoted to the publication of the results of original research and field experiments. (Established 1931. Published in February, April, June, August, October and December. Prepayable subscription Rs. 15 or *24s.* per annum inclusive of Indian postage. Price per part Rs. 3 or *5s. 3d.* inclusive of Indian postage.) Volumes I to VI complete are available.

3. The Indian Journal of Veterinary Science and Animal Husbandry

A quarterly Journal for the publication of scientific matter relating to the health, nutrition and breeding of live-stock. (Established 1931. Published in March, June, September and December. Prepayable subscription Rs. 6 or *9s. 9d.* inclusive of Indian postage. Price per part Rs. 2 or *3s. 6d.* inclusive of Indian postage.) Volumes I to VI complete are available.

4. Scientific Monographs of the Imperial Council of Agricultural Research

NCAG—SM/1 — No. 1. The Fungi of India, by E. J. Butler, C.I.E., D.Sc., M.B., F.R.S. and G. R. Bisby, Ph.D. (1931). Price Rs. 6-12-0 or *11s.* (As. 8).

NCAG—SM/2 — No. 2. Life-histories of Indian Microlepidoptera, Second Series : Alucitidae (Pterophoridae, Tortricina and Gelechiadae), by T. Bainbrigge Fletcher, R.N., F.L.S., F.E.S., F.Z.S. (1932). Price Rs. 3-4-0 or *5s. 6d.* (As. 6).

NCAG—SM/3 — No. 3. The Open-Pan System of White-Sugar Manufacture, by R. C. Srivastava, B.Sc. (1935, 2nd edition). Price Rs. 3-2-0 or *5s. 6d.* (As. 9).

NCAG—SM/4 — No. 4. Life-histories of Indian Microlepidoptera : Cosmopterygidae to Neopseustidae, by T. Bainbrigge Fletcher, R.N., F.L.S., F.E.S., F.Z.S. (1933). Price Rs. 4-8-0 or *7s. 6d.* (As. 8).

NCAG—SM/5 — No. 5. The Bombay Grasses, by E. J. Blatter, S.J., Ph.D., F.L.S. and C. McCann, F.L.S. Illustrated by R. K. Bhide. Price Rs. 20-12-0 or *32s. 6d.*

NCAG—SM/6 — No. 6. Helminth Parasites of the Domesticated Animals in India, by G. D. Bhalerao, M.Sc. Price Rs. 7-12-0 or *13s. 3d.*

NCAG—SM/7 — No. 7. Influence of Manures on the Wilt Disease of *Cajanus indicus* Spreng. and the Isolation of Types Resistant to the Disease, by W. McRae, M.A., D.Sc. (Edin.), F.L.S. and F. J. F. Shaw, D.Sc (Lond.), A.R.C.S., F.L.S. (1933). Price Rs. 2-4-0 or *4s. 3d* (As. 5).

Agriculture & Live-stock in India

Vol. VII, Part IV, July 1937

EDITORIAL

SUGARCANE AGRICULTURE IN INDIA

RECENT PROGRESS IN RESEARCH

I

SCIENTIFIC research into the problems of sugarcane agriculture has been carried on in India for many years by the Central and Provincial Departments of Agriculture, but the increase in cultivation, consequent on the protection afforded to sugar in 1930, demanded and was met by an increase in scientific activity. Its obvious manifestation was the establishment of a chain of research stations dealing with this crop, in the sugar-growing Provinces and States of India. largely subsidised by grants from the Imperial Council of Agricultural Research. In addition, work on special problems, similarly subsidised, has been undertaken by certain University workers.

The need for many stations is clear to all who know how diverse are Indian conditions. Soil, climate, water facilities and economic factors vary. In one part of India canes must tolerate extremes of heat and cold, in another they must be able to stand up to excessive rainfall. In one part they grow in deep alluvial soil. In another (and by no means the least productive area) they grow in two feet of earth over disintegrated trap rock.

If, in connection with sugarcane, we were to consider purely agricultural objectives, we might say that the aims of research are : high yield, high sugar content, no soil deterioration (and if possible, soil improvement).

But these things are obtained *at a price.* Moreover, sugarcane agriculture is a means of human livelihood, hence there must also be taken into consideration the economic side of production, including the utilisation of subsidiary products, and the net return to the man who grows the cane.

None of these aspects have been neglected, but at the moment we shall consider only a few of the lines of advance on the purely agricultural side.

II

The main research problems of sugarcane agriculture may be roughly classified into three groups, namely—

(1) the breeding and testing of new cane varieties,

(2) the study of the soil and its treatment (including not only soil analysis, but all experimentation in manuring, cultivation and irrigation), and

(3) the study of the response of the individual plant to its surroundings (*i.e.*, plant physiology).

Of course, no one of these can be isolated from the others, and the desired end-product must be a synthesis of the result of all the work in these branches. We have now, as a gift of science, the many varieties mainly issuing from the Coimbatore station. Twenty-five years ago not one of these canes existed. They have been produced by the crossing of many types of cane, including wild canes, and selection among their progeny. The variety of wild canes in this country has to be seen to be believed. At Coimbatore there is a partial collection of these, ranging from what looks like a low desert grass at the one end of the scale to a tall slender cane-like plant at the other. Toughness of constitution is the main contribution of the wild canes. We are by no means at the end of cane-breeding. Some of the more recent products such as Co 419 and Co 421 outyield in suitable circumstances anything previously produced. Moreover, mutilation of buds (at Coimbatore) and the application of X-rays (at Mysore) are artificially producing new varieties, some of which may be of value.

After the production of a new variety comes its testing, and the uninitiated can hardly grasp how thorough and reliable are the methods now used. A whole new branch of applied mathematics has grown up round the field-testing of varieties, and results have a known degree of significance. This is worth keeping in mind by those who are impatient for new varieties to be released before we know their performance. It is no easy matter to recall a poor variety once it is distributed.

Another thing worth keeping in mind is that there is no universal cane variety suitable for all conditions and there is not likely to be, but the choice is now so great that a cane variety *can* be found for almost any agricultural conditions in which cane will grow. In connection with soil treatment, manuring perhaps strikes the public imagination most Manuring problems are not peculiar to sugarcane, but it definitely pays to manure cane and the

questions arise as to the manures to be used, the amounts and times of their application and the balance between manurial elements. The last-named point has turned out to be very important, as unbalanced manuring, especially an excess of nitrogen. while it may increase yield, depresses sucrose. There is also the important question of the place of organic manures, and this leads on to the very important problem of the activities of soil bacteria, and so to the many other problems of pure soil science.

One of the most striking results of recent soil investigation is that it is not only the elements in the soil and their amount that matter but also how they are held. They may be in a form in which they are not readily available to the plant, even with irrigation. On the other hand, a soil may contain an excess of an element held in a peculiar way which makes barren a soil that one would imagine should be fertile. These are problems largely dealt with by colloid chemistry, one of the most complex of studies.

Plant physiology deals with similar problems but in a more intense way. The individual plant is put in the witness box (often a large iron drum or oversized earthenware pot) and closely interrogated. Very accurate measurements and weighments are taken of all the plant takes in and gives out, and from these minute studies valuable guidance is got for the larger field-experiments.

III

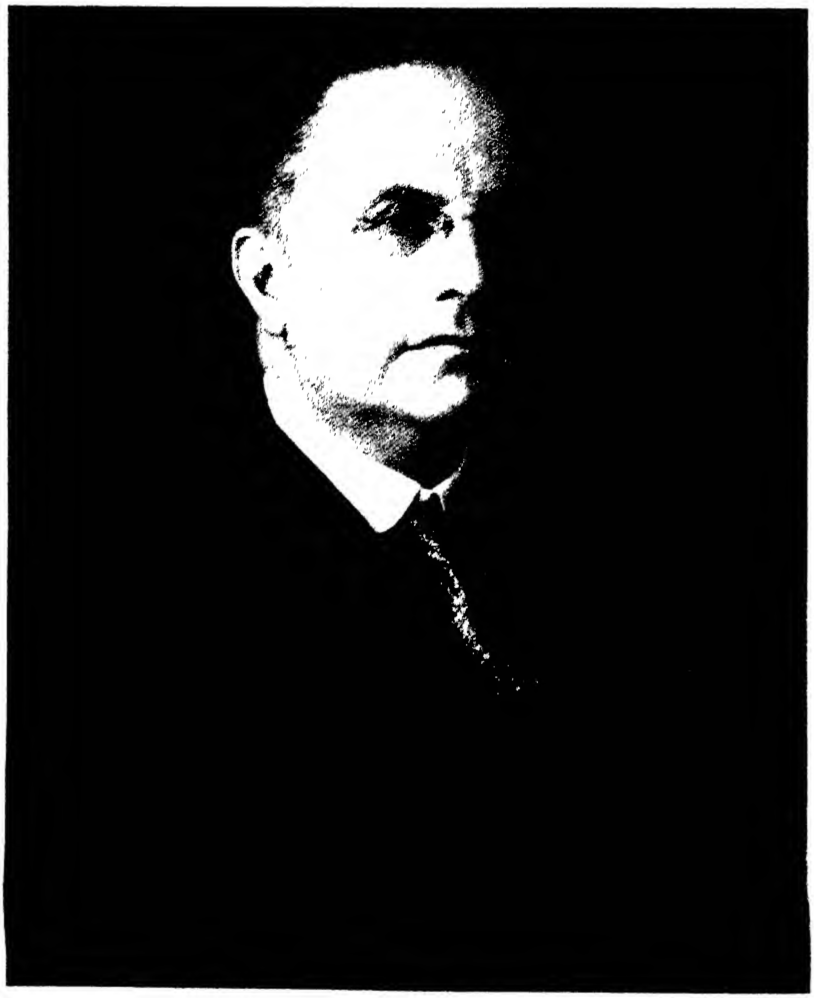
The Sugar Committee of the Imperial Council of Agricultural Research which met recently in Simla discussed as part of its duties all the progress reports from these research stations and all the programmes for future work. At its last meeting it also decided that the results of work done up-to-date should be summarized and made available for the lay reader and it is hoped that such a compendium will be very helpful to all desirous of understanding this interesting branch of the application of science to agricultural practice.

In the meantime, it may be worth while to mention briefly what has been done and what is being done to put research results into agricultural practice. The area in India under improved cane varieties has, due to the propaganda activities of the Agricultural Departments, increased year by year from 1,168,000 acres in 1931-32 to 3,071,153 acres in 1935-36.

As regards yield, *i.e.* tonnage of cane per acre, there has also been a very considerable improvement. Thirty tons of cane per acre and over is usual on the Shahjahanpur Experiment Station. In the Bombay Presidency, using P O J 2878, E. K 28 or Co 360, yields of forty tons cane per acre are now not uncommon in the fields of the best cultivators and the Bombay sugar factory estates can and do get yields of fifty tons with the same varieties. At Jorhat in Assam in 1935-36 Co 419 gave fifty-four tons per acre, the highest tonnage ever recorded on the farm. These are merely examples of what can be done with treatment that is by no means abnormal.

Good varieties properly manured and giving higher yields necessarily lower production costs. Production costs naturally vary very much from one sugarcane area to another but, roughly speaking, it may be said that the cost of production is, in ordinary circumstances, four to six annas per maund in the United Provinces and three to five annas per maund in Bihar, but in the latter place, by scientific management, it can be and has been reduced to two annas in certain cases.

Very substantial financial help has also been given to the introduction on a large scale of all kinds of improvement in sugarcane agriculture by the action of the Central Government in setting aside an amount equivalent to one anna per cwt., as a fund to be distributed among the provinces where white sugar is produced, for the purpose of assisting the organisation and operation of co-operative societies among the cane-growers so as to help them in securing fair prices, or for other measures directed to the same end. The total amount allotted to provinces in the last three years was Rs. 10 lakhs in 1934-35 and 1935-36 and Rs. 8,52,000 in 1936-37 with the prospects of increased amounts in the future. Mention should also be made of Rs. 2½ lakhs annually spent on the Imperial Institute of Sugar Technology, Cawnpore. Not only, therefore, is research being carried on with ever-increasing intensity and efficiency but the results are reaching the cultivator and there has already been a rich harvest from the money expended on research.



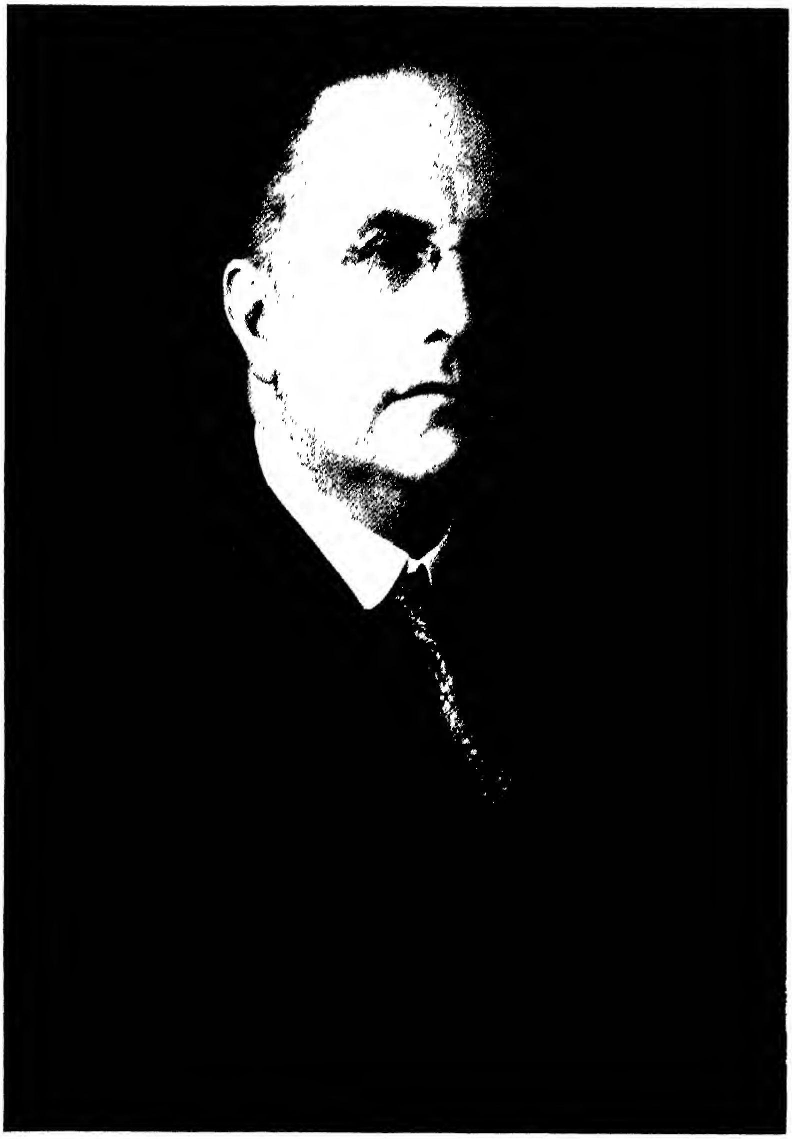
Sir Frank Noyce, K.C.S.I., C.B.E., I.C.S.

ORIGINAL ARTICLES

SIR FRANK NOYCE, K.C.S.I., C.B.E., I.C.S.

An Appreciation

The departure in April last on a short period of well-earned leave preparatory to retirement of Sir Frank Noyce marked the retirement from active work in India of one who has exercised a much greater influence on the development of agriculture and industries in India than any other official during the last quarter of a century. A scholar and a prizeman of St. Catherine's College, Cambridge, Sir Frank Noyce entered the Indian Civil Service in 1902 and was posted to Madras. He speedily came into practical contact with Indian agriculture when he was appointed Special Assistant Settlement Officer in 1906, and as he himself has said on more than one occasion the intimate knowledge of rural conditions thus gained, made a lasting impression on his future outlook. In 1910 he was appointed Under Secretary to the Government of Madras and in 1912 he made his first journey to Simla to become Under Secretary to the Government of India in the Department of Revenue and Agriculture. After officiating as Secretary of that department in 1915-16, he was appointed Secretary of the Indian Cotton Committee in 1917. The work of this Committee which was presided over by Sir James (then Mr.) MacKenna, Agricultural Adviser to the Government of India, laid the foundations of future progress in cotton improvement in India and led to the establishment of the Indian Central Cotton Committee, which as a result of its recommendation came into being in 1921. Hardly had this Cotton Committee completed their labours when Sir Frank Noyce was appointed Controller of Cotton Cloth in September, 1918. Here he had to deal with the shortage of supplies arising from war conditions and the necessity of rationalising production in Indian mills to meet the most immediate demands. It is common knowledge that he carried out a difficult and invidious task in a manner which gained the confidence of the Indian textile industry. The success of the Indian Cotton Committee and the practical character of its recommendations led the Government of India in 1919 to appoint Sir Frank Noyce Vice-President, and subsequently President, of the Indian Sugar Committee which was appointed "to examine the problem of organising and developing the Indian sugar industry in all its bearings and to advise whether a definite and co-ordinated line of policy can be laid down". This Committee performed its task as thoroughly as its predecessor and made many far-reaching recommendations which have since been the basis of much successful work. But when the Sugar



Sir Frank Noyce, K.C.S.I., C.B.E., I.C.S.

ORIGINAL ARTICLES

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Committee reported in 1921 the shadow of the first retrenchment campaign was already perceptible and some of their recommendations were only put into effect in 1930 after the establishment of the Imperial Council of Agricultural Research. Indeed, one of Sir Frank Noyce's last official acts was formally to open the Imperial Institute of Sugar Technology at Cawnpore, which gave effect to one of his Committee's most important recommendations.

In 1920 Sir Frank was a member of the Burma Land Revenue Committee, and for a time, in 1922, Indian Trade Commissioner in London whence he returned to his province. As Secretary of the Development Department of the Madras Government he exercised an important influence in the further development of what was already a strong agricultural department. Then, for a time, he was lost to agriculture, being successively President of the Indian Coal Committee, Commissioner of Labour in Madras and Secretary to the Madras Government in the Local Self-Government Department, and in 1926 he was appointed President of the Indian Tariff Board for the Cotton Textile Industry. During that period he left his mark on Indian industrial development. In 1927 he was attached to the Royal Commission on Agriculture in India, first as Financial Adviser and subsequently as Assistant Commissioner. His work on the Commission was recognised by a Knighthood in 1929 and it is in connection with his work on the Royal Commission that most agricultural officers remember him. After a short period of leave Sir Frank Noyce was appointed special officer at the Headquarters of the Government of India to deal with the recommendations of the Royal Commission and to design the administrative machinery required to give effect to them. In particular, he played an active part in the establishment of the Imperial Council of Agricultural Research and initiated a number of developments and improvements at the Pusa Research Institute. He was appointed Secretary to the Government of India in the Department of Education, Health and Lands in 1929, and during three most important years of development and reorganisation, hampered at the end by financial stringency, he was a tower of strength both to the Imperial Council of Agricultural Research and to the Imperial Department of Agriculture in India. He was appointed Member of the Executive Council of the Governor-General, in charge of the Department of Industries and Labour in 1932 but retained his interest in agricultural development and continued his membership of the Governing Body of the Imperial Council of Agricultural Research. His sage advice and wise guidance were always at the disposal of the Council and only those who were intimately connected with its working knew how much he did to guide development in sound and profitable directions.

But Sir Frank Noyce will be remembered by agricultural officers in India as much for his personal charm as for the great work he did for agricultural and economic development of the country he served so well. His appreciation of scientific problems and of a research worker's outlook of life made him many friends among agricultural and veterinary officers who appreciated his ready sympathy

and interest in their work. Those whose work brought them into more intimate contact with him were impressed alike by his broad-mindedness and his thoroughness. Though a master of detail he had a quick appreciation of the essentials of any proposal and in consequence was at all times ready to adjust details in order to meet new conditions, or to placate opposition, without surrendering on matters of principle.

At the Annual General Meeting of the Imperial Council of Agricultural Research held in New Delhi in January 1937 the following resolution was passed :

> "The Imperial Council of Agricultural Research desires to place on record its high appreciation of the great services rendered to Indian agriculture by the Hon'ble Sir Frank Noyce and wishes him all happiness in the future ".

In putting this resolution before the Council the Hon'ble Sir Jagdish Prasad, Chairman of the Council, said : —

> "During the time that he has been in India both while he was in the Madras Presidency and after his elevation to the higher regions of Simla and to the Government of India, I think there have been really few truer friends of India whether in the field of agriculture or of industry than Sir Frank Noyce. He has devoted his great abilities with the utmost sincerity to the advancement of the material interests of the country in which he has spent the best part of his working years. In his departure we are really losing not only a very wise guide in our deliberations but also a great friend of the country and one who has done a great deal for the cause of agriculture ".

With these words this brief appreciation of Sir Frank Noyce's service to Indian agriculture may appropriately end. All readers of *Agriculture and Livestock in India* will join with the Agricultural Research Council in wishing Sir Frank and Lady Noyce a very happy time on their return to their own country. [B. C. B.]

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

II.—THE BURMA CULTIVATOR *

BY

W. M. CLARK, M.B.E., B.Sc., I.A.S.

Deputy Director of Agriculture, Northern Circle, Mandalay

THE majority of present-day Burmese cultivators live in the heavy-rainfall, paddy-growing area of Lower Burma, but as it is impossible to dissociate an inhabitant of any country from the influences which have helped to mould him and his ancestors, the composite cultivator whose picture is drawn in this note has been taken as living in the hot 25 to 40-inch rainfall belt of Upper Burma.

The Lower Burman is a one-crop man, a paddy cultivator, and he grows the crop on a fertile soil under a rainfall of 90 inches or more which never fails, making of him not so much a cultivator as a paddy miner. These conditions will have their influence in the future, but the typical faults and virtues he has inherited were developed under the totally different conditions of the dry zone from which his immediate parents, grand-parents or perhaps great grand-parents came. Few Burmese cultivators in Lower Burma can carry their ancestry very far back in Lower Burma as it was only effectively occupied by them after the opening of the Suez Canal in 1869 and the rise of an export trade in rice. In the dry zone, where the Burmese people grew into a nation, the rainfall can never be relied on and crops may indeed fail, but seldom so badly as to cause actual famine. Certainty of a crop, however, can only be had by constructing irrigation works and even these depend on rather erratic streams. These are the influences which have moulded the Burman.

The Burmese cultivator is of Mongolian stock, small and lightly built (a boxer of 9 stone weight is a rarity), with high cheek bones and wide-set eyes in a face with a light brown skin. He wears his hair long or he shaves it off and on high days and holidays puts round his head a gay coloured piece of cloth known as a *gaung baung*, while he dresses the remainder of his body in an equally bright-coloured skirt called a *longyi*, a white shirt and a white or dark jacket. It is one of the great joys of living in Burma that the ordinary people are so colourful in their dress and mix their colours with such great taste. It is rare indeed to meet a Burman wearing colours which clash.

* This series of articles began in the May issue of this Journal with an article on "The Bengal Cultivator" by the late Mr. Kenneth McLean. The series will be continued in succeeding numbers of this Journal, and it is hoped finally to publish the whole series of studies as a book.—[Ed.]

As has been indicated, the Burman is fairly certain of his food-supply and it is centuries of experience of such a state of affairs which have probably induced in him that cheerful outlook which expresses itself in his gay clothes, his casualness at times, his improvidence, but above all in his open-handed kindness. Even the poorest cultivator will put on his kettle to give a visitor tea. An officer of the Agricultural Department can speak perhaps with a greater feeling of certainty on this general trait of kindness than any other officer in Government service. It must seem astounding therefore to an outsider to hear that this land of kindly people and Buddhists has an appalling record for crimes of violence due perhaps to a lack of control that may go with a cheerful and casual nature.

The Burman's other big weakness is his love of a gamble. He is a resourceful person, as is demanded by the climate of his land, and hard working and persistent up to a point, but his climate also allows him to gamble on getting, say, a late sesamum crop and those who can resist the temptation and work to get more certain but lower-priced crops are few and far between.

But like people in other lands his faults and his virtues are strangely mingled and among his virtues may be counted his sense of brotherhood with other men, and the absence of caste. The rich man of to-day may be the poor man of to-morrow and he never thinks of holding aloof from his poorer neighbours. His riches certainly command respect and he may hold many of his neighbours in his debt, but he is never relentless and in time of stress, as happened in the first year of the last slump, many a rich cultivator in the villages of Burma reduced his demands and gave away paddy in order to keep his poorer neighbours going. Burmans are practically all Buddhists and the instruction to give to those in need fell in Burma on fertile soil.

The slump period also showed up the Burmese cultivators' general habit of being especially kind to children. The parents might have no food and be reduced to living on water every fourth day or so but their children never went hungry. Nothing was said but they were made welcome round the rice bowls of their richer neighbours. Children have a happy time in Burma and may in fact be indulged too much, but, if so, it is a fault which arises from a dislike of appearing unkind and in a desire to give rather than to take so that while we may regret the results we cannot help liking the reasons for them.

The usual village in the dry zone of Burma is a collection of houses of which the uprights and perhaps the floor are made of wood, the walls of bamboo matting and the roof of grass. The floors are usually built eight feet or so above ground level and the part underneath gives space for a loom on which the women weave cotton cloth for home use and for a platform which is used in the heat of the day for sleeping on, often for meals, and frequently as a platform on which the husband and wife sit of an evening and chat with their neighbours. There also elderly

men may be seen of an evening playing the quiet games of chess or dominoes common to all countries. Cultivators anywhere are usually glad to sit down at the end of the day and it is only the young who have energy left to play the popular game of *chinlon*. This is a game in which three or more young men with their skirts tucked up to give their legs freedom stand in a circle and endeavour to keep in the air a ball made of cane work. There is no score, no gambling and no quarrels. It demands constant attention and a quick eye and is a very much more strenuous game than it looks. More recently the English form of football has caught on in the bigger villages. Young as well as old are awake and ready to try new things. Burma is alive.

Living in an area in which resource is demanded, the Burmese cultivator has developed a fair degree of skill in his practice of growing dry crops. He appreciates the value of timing his operations to the necessities of the soil and rainfall and he will work hard and work long hours in order to take advantage of any favourable shift of weather. He is quick to appreciate the points of a new type of plough or intercultivator, something from which an immediate advantage can be obtained, and, once convinced of its value, will immediately adopt it. But, like cultivators anywhere, he considers things for a long time before he finally decides and, very sensibly, he does not change his practice simply because a Government officer tells him it will pay him to do so. Also he is very much an individualist, probably all Buddhists are, and although he will listen to what other people may say he likes to feel he has taken a line of his own, a trait which is apt to make public meetings rather prolonged affairs.

Two photos are shown (Plate XX). One is a family group with the lower part of a Burmese house in the background. Note the love of flowers and the kerosene tins used as flower pots. The cultivator and his wife are typical in everything but the lady's lack of a smile. Next the mother is a little girl. The blazers and the shorts had to be included and in their way are typical of modern Burma.

The other photo is a close-up of the husband. His head cloth is his spare *longyi* or skirt. He will bathe at mid-day in the one he is wearing, slip on the one now covering his long hair and wash the dirt out of the one he takes off. To-morrow he will have the *longyi*, not in the picture, as a head cloth and be wearing the one now on his head. The pipe and the safety-pin are modern touches.

Fig. 1. The Burma cultivator

Fig. 2. The Burma cultivator and his family

FIG. 1. The Assamese cultivator

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

III.—THE ASSAM CULTIVATOR

BY

P. N. CHAKRAVARTY, B.A., M.S.A. (CORNELL)

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THE province of Assam consists of three distinct tracts: (1) the Brahmaputra Valley consisting of six districts (which may be called Assam proper), (2) the Surma Valley consisting of the two districts of Sylhet and Cachar and (3) the Hills. The type of cultivator in each is entirely distinct. There is, however, little to distinguish the cultivator of the Surma Valley from his prototype in Eastern Bengal. The population is predominantly Mohammedan and the climate and the physical conditions are very similar to those of the neighbouring province of Bengal. In the Brahmaputra Valley, the population is of mixed origin with a sprinkling of Mongoloid extraction and preponderately Hindu. This is, however, being changed by constant immigration of Mohammedan cultivators from the district of Mymensingh. The Hills again have their own distinctive types. Each hill is slightly different from the other but the Khasi cultivator is the most energetic and intelligent. A description of an Assamese and a Khasi cultivator is given in the following notes.

The Assam cultivator proper

In spite of the economic depression and the rapidly changing world conditions, the Assamese cultivator still continues a true son of nature depending entirely on mother earth for his subsistence. He is straightforward and simple and can only see what lies immediately before him. He is unwilling to make what he considers unnecessary exertions and does not see the necessity of providing against rainy days. He likes to have plenty of leisure and an easy time and does not worry himself beyond his immediate needs. The damp climate of Assam has perhaps partly helped in shaping his character. Paddy is his main crop which perhaps requires the least exertion to grow. He is, however, extremely busy and quite hard-worked during the months of June, July and August which form the main paddy-growing season and again during the harvesting months of December and January. Except during the above months he rarely works in the afternoon. Female folk play an important part in the life of the Assamese cultivators not only for household management but also for such active operations

as transplanting paddy seedlings, harvesting, threshing and fishing. The women are expert in weaving, ignorance of which is considered very derogatory for an Assamese woman. Until recently all the cloth required for the household was woven at home by women folk and it is only during the last two years that mill-made cloths are finding their way into the interior of Assam.

An Assamese cultivator with his wife usually cultivates about five acres of paddy and this is often supplemented by vegetables, mustard and a small patch of sugarcane. Any cash that he requires for paying land revenue and for purchasing such requirements as salt, cloth, etc., is found by selling a part of the paddy and perhaps *gur*. He has not yet been accustomed to grow any crops requiring strenuous cultivation and attention. Irrigation is almost unknown. Fruit trees such as plantains and papayas always form a part of the homestead. He lives in small thatched huts supported by bamboo posts (a few clumps of which are grown in the homestead) with mud floors. He is usually quite clean and a daily bath is a routine. He is very fond of chewing *pan* and betelnut and always grows a few areca palms supporting betel vines. His food is very simple consisting of rice, curry and small fish with some green vegetables but a cup of tea in the morning and afternoon is a necessity. He is not fond of spices but curd is highly relished although not always available. The cattle of the country are very poor, an average cow giving about ½ lb. of milk per day.

His vices as well as pleasures are very simple. His usual enjoyment is some company singing in the evening accompanied by drums. Some castes are very fond of *loupani* (home-brewed wine) but they rarely get drunk. The great annual festival is the *Bihu* which comes sometime in March and marks the end of the harvesting season. This is marked by plenty of eating, drinking, singing and merry-making for days and nights together, the young men and girls taking active part.

The Khasi cultivator

The Khasi race inhabits the middle portion of the Assam Range of hills. They are of Mongolian extraction and their system of inheritance is matriarchal. Consequently the womenfolk occupy an important position in social life, which is reflected in their freedom and equality with men. The women take part in all manual labour and very often work even harder than the men. The Khasis are very democratic and manual labour is not looked down upon. The son of a Government officer drawing Rs. 300 will be found to work as an ordinary carpenter and *vice versa*.

They are medium in stature and individuals vary little from the general type. A good sense of whimsical humour is evident in their intercourse. Their country becomes alive to them in their stories and traditions. Streams run races, rocks fight each other, and places are named after momentous events which occurred in olden times. Upright stone monoliths, some of great size, commemorate the

The Khasi cultivator

dead. Inclined to be a gambler, but a cheerful loser, the Khasi likes his drink, his smoke, and his *pan*. Village meets village in archery competitions twenty or more aside, shooting at a remarkably small target.

As an agriculturist the Khasi is a skilled fruit and vegetable grower, but the scale of agriculture is small. The hoe is used, the bullock plough being seen only in rice-growing areas, in the Valleys. His money crop is the potato, in the growing of which he is very knowledgeable, having evolved a method of obtaining a subsidiary winter crop. Harvesting his crop in July-August, he plants specially sprouted seed again in September, mainly with the object of obtaining freshly harvested winter seed for the next spring. For his annual crops, potatoes, millets, soybeans, and roots he uses the *jhum** method of the hill tribes. Next to the potato crop of the higher plateau, come the oranges and *pan* of the southern slopes. For fruits and vegetables he has his patches of garden land. The southern slopes of the Cherrapunjee Hills are, however, famous for the 'Khasi oranges' which are grown on a field-scale.

*The surface is scraped and divided into beds and covered with dry branches and twigs which are burnt. This minimises after cultivation, but is a very wasteful practice as a *jhumed* land has to be left fallow for several years.

LIVE-STOCK IMPROVEMENT IN INDIA

BY

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Since His Excellency the Marquis of Linlithgow became Viceroy of India, there has been a great awakening of interest in the improvement of live-stock and of cattle in particular. The matter has been repeatedly discussed with provincial representatives, and this note is intended to put together in comprehensive form recommendations and conclusions as to the lines along which it seems that the development of live-stock and live-stock industry should proceed in India.

General conditions

From the discussions which have taken place it is evidently agreed that as far as cattle are concerned, the only sound policy for the plains of India is to improve the best indigenous breeds, by systematic selection and proper feeding and management, since European breeds have proved generally unable, even under the best conditions, to maintain themselves satisfactorily within the tropics. This general principle has been found to apply in the case of milch goats also, but in the case of poultry imported European breeds thrive well and seem on the whole to be less susceptible to disease than the ordinary village fowl. In the case of sheep, it has generally been found difficult to maintain European breeds in the plains, though some success has been obtained in establishing cross-bred merino sheep for the production of better wool. In horses, the improvement effected by imported stock has been very great, though the expense of rearing high-grade stock is generally beyond the means of the ordinary breeder. In the case of donkeys, the imported jack has done much to improve village stock.

Improvement of cattle

It is now abundantly clear that the efforts which were made in the past to improve cattle by breeding limited numbers on provincial farms has, in most provinces, had little lasting effect on the bulk of the relatively enormous numbers to be dealt with. The reasons for this are not difficult to understand for it is obvious that the numbers of suitable sires which could be produced, on ordinary Government farms of limited extent, could never be sufficient directly to affect more than an almost infinitesimal proportion of the huge numbers which exist. Moreover, fatal changes of policy, or change of control for financial or other reasons

have intervened to dash any hope of achieving the extensive results which might have been obtained by skilful handling, on a definite programme, of such limited numbers of sires as were generally available.

On the other hand, in provinces where systematic measures for the improvement of live-stock have been carried on generation after generation by animal husbandry organisations, such as the Veterinary Department of the Punjab, and to a limited extent the live-stock sections of certain Provinces and States, steady improvement has been effected corresponding with the extent to which the Department concerned has been expert in animal husbandry work and devoted to the care and development of live-stock.

Furthermore, where due attention has been paid to purity of blood the improvement has been maintained and an interest in pedigree stock aroused, which augurs well for the future; provided that adequate measures are taken to maintain proper pedigree registration.

In view, however, of the steady reduction which is taking place in grazing areas, and the circumstances in which breeding is generally carried on in India, it seems clear that degeneration of stock is likely to continue unless more adequate steps are taken and a larger proportion of funds are allotted for their better care and development. At present, for the whole of India, including the Punjab, the total allotment for animal husbandry, including veterinary work of all kinds, is only about half of the total allotted for plant husbandry, and it seems clear that the first essential for the systematic improvement of live-stock in India is an adequate animal husbandry organisation, in each Province or State, with no other interests to consider than the welfare and economic exploitation of stock, and with a more adequate share of the total amount of money allocated for the development of agriculture as a whole. Indeed it does not seem reasonable to expect adequate or lasting results in the improvement of live-stock or in the profitable development of animal industry unless and until such organisations are everywhere available.

The constitution and control of such organisations, and the powers and funds to be placed at their disposal, are thus matters of vital importance which need to be very carefully considered by Provinces and States. It is not merely a question of veterinary or agricultural control, but it seems obvious that to develop live-stock properly such departments should be under the control of suitably trained specialists in such work, devoted solely to the interests of live-stock.

Selection of breed and type

Given a suitable animal husbandry department, the first thing to be done is to consider what kind of stock is to be raised, and it is essential at the outset to arrive at sound decisions as to the particular breeds and types which are likely to suit the circumstances and localities in which breeding is to be carried on. At the risk of stating the obvious, it must be pointed out that nowhere in the world is it

sound policy to attempt to produce a type of stock which is not naturally suited to the local conditions of soil, climate and environment. That high-class stock can be produced in areas which are not naturally suitable for them, there is no question, but the cost of doing so is prohibitive for the ordinary breeder and, apart from the constant struggle against adverse circumstances which would be entailed, there is the difficulty that—if of a breed or type different from the local stock—the male progeny, when used as sires, would be likely to do more harm than good. Moreover, in order to obtain fresh blood and to maintain type in the parent herd, it would be necessary constantly to import sires from elsewhere.

Type

The decision as to the particular type to be bred, *e.g.*, working type or milch type, is another matter which requires very careful consideration since, in all breeding work, strict breeding to a type and unbroken continuity of policy are all-important. In this connection, the question whether it is feasible to produce cattle which will breed true for a combination—in high degree—of working capacity with a capacity for milk production, is one of the matters which have to be considered. This question has already been discussed at length in my note " The Inadequacy of Dual-Purpose Cattle as the Goal in Cattle Breeding in India ",* the point of which appears to have been missed by many. In that note it was not intended to deny that it is possible for an expert breeder to achieve dualty of purpose—up to a certain point—provided that he is at liberty to select freely and to discard animals which do not show the desired combination of factors. But it seems obvious that the Indian peasant, who is not in any way an expert breeder of pedigree stock, and who maintains usually not more than one or two cows in a village herd, to meet his own requirements, cannot hope to be in this position. He is not permitted by his religion to slaughter cattle and can only hope at best to be able to mate his cow with a sire of the type he wishes to emphasize in the progeny. If he wants more milk, he would like to be able to mate his cow to a milking-type bull, and would have a much better chance of getting a high-yielding heifer than if only dual-purpose sires were available. If he requires more powerful-work cattle, he would naturally prefer a sire of pure working type. Ordinary commercial stock are commonly bred on these lines even in advanced countries, but it is a truism that to make and maintain progress, the breeder of pedigree stock must specialise all the time on one particular type.

For dairying in particular it is necessary to specialise, since if the milk producer is to have a fair chance of making a financial success of his business, he must have high-grade milch-cattle, and for that reason, in areas where dairy stock are largely bred, it is essential to develop high-milking strains. Where the sale of bullocks is the traditional policy, breeding specially for work is likely still to be

* This *Journal*, 6, 389.

carried on by semi-nomadic professional breeders so long as suitable grazing remains available at low cost.

Between these extremes lie the great majority of cultivators who keep one or two cows and produce less specialised ' general utility ' stock which, though useful for their requirements, cannot in view of their heterogeneous origin, be relied upon to breed true and therefore cannot be described as ' dual—purpose ' stock in its strict sense. To develop and maintain Indian village cattle as true breeding dual-purpose stock would moreover be a collossal undertaking.

Furthermore, though much is said of the breeding of dual-purpose cattle in this country, the method usually adopted appears to be to pay strict attention to milk recording and to retain the best-milking strains until such time as definite signs of unsuitability for draught purposes appear in the progeny. When that time comes the breeder will be faced with a decision whether to retain any high-yielding milk-strains thus evolved, or to destroy the advance thus achieved by crossing back to a working-type bull. What the answer must be in the interest of progress is not difficult to foresee and in the meantime more milk is being bred into the stock. Along these lines so long as promising dairy strains are not crossed back to a work-type bull there need be no objection to so-called dual-purpose breeding but high capacity for work and for milk production is physiologically incompatible, and instances are not wanting in India where attempts to retain these factors, in equal degree, in one and the same strain, have led to marked deterioration of previously valuable stock. For, beyond a certain point any marked advance in either direction must be cancelled out and the work must to that extent become Sisyphean while any progress towards fixation of a type which should breed true for either factor in high degree must constantly be vitiated.

Even the combination of milking capacity with meat production, qualities which are not so incompatible as are capacity for work and milk production, has been given up in other countries, and it seems certain that a similar policy must eventually fail in India since it will not produce that definite segregation of types which has been found essential in every progressive country in the world.

The choice as to which type of bull to use must however largely be influenced by local consideration and the aim of governments should be to provide the type most needed in the locality or, where possible and advisable, to make milking-type as well as working-type bulls available. Where the supply of liquid milk is a profitable undertaking and where there are good facilities for the production of fodder crops, the choice would obviously fall on the dairy type, but the ordinary cultivator should as far as possible be in a position to choose the type of sire he considers the most suitable for his particular cows and for his requirements.

Cow or she-buffalo

Similarly, a choice has to be made as to whether cows or she-buffaloes are to be maintained. Here again there is some diversity of opinion and the choice is likely

ultimately to be governed by financial considerations; though there is another aspect to be considered. Where abundance of coarse fodder is available, and where the production of ghee is a major consideration, or where liquid milk is produced for sale—usually by unscrupulous and uncontrolled hawkers – the she-buffalo is at present commonly preferred. But investigation has shown that pure-bred cows of certain Indian breeds of cattle can, in a comparatively few years, be improved by proper feeding and management to a point where they can compete successfully with the buffalo in economy of milk or butter-fat production. In view, therefore, of the greater general utility of cows, as compared with buffaloes, in that they produce better-working animals as well as milk, and of the important fact that cows' milk is a much better food, particularly for children, than buffaloes' milk watered down to the same level of butter-fat, the question whether cows should not be bred and as well fed and maintained as are she-buffaloes is one which merits careful study.

The breeding of working-type cattle

In areas where the demand for milk and dairy products is limited and where facilities exist for raising cattle on extensive grazing, the breeding of working-type animals is the traditional policy and seems likely to continue because it is difficult to carry on dairying under the semi-nomadic conditions of life of such breeders. But it is perhaps not sufficiently known that even among breeders of working bullocks a great deal of their total income is derived from the sale of ghee, *e.g.*, we have recently been shown, by representatives of large numbers of professional cattle dealers and breeders in western India, some of whom themselves breed and rear large numbers of working bullocks, that the income derived from their sale is not much more than one-fourth of that derived from the sale of ghee and other dairy products. The position is somewhat similar in other parts of India and owing to the growing realisation of the essential importance of milk in human diet, it seems likely that the market for liquid milk will improve, while already in certain large areas, milk collection for ghee or cream production is being organised on a big scale through the use of small cream separators. Thus, milk seems likely to become more and more an important consideration for the breeder of work-cattle.

Capabilities of indigenous breeds as milch cattle

A careful analysis of available records has shown that in different parts of India there are breeds, of pure Indian cattle, which respond readily to proper treatment and which possess considerable potentialities for milk production. But to ensure rapid progress it is obvious that milking strains must systematically be segregated out from the ordinary cattle of the country and mated with bulls, of known pedigree, from cows of high-milk-yields. In this way, in course of time, definite milking-type Indian cattle should become available which could be relied upon to breed true for milk and in view of the great need for such cattle, the Imperial Council of

Agricultural Research is now engaged in instituting official herd books for seven of the best known milch breeds of India.

Cross-bred Indo-European cattle

For years past it has been demonstrated by organisations such as the Military Dairy Farms that cross-bred cattle from Indian cows by sires of European blood, in spite of the heavy capital and recurring expenditure involved, are generally, under their special conditions of management, more profitable dairy animals than ordinary Indian cows. On the other hand, there is ample evidence to show that where control is inadequate or inexpert, the pursuit of such a policy leads to immediate loss of type, rapid degeneration and high susceptibility to disease.

But a policy of cross-breeding with European cattle is not in any case within the reach of the ordinary Indian milk producer, who is not at liberty to discard freely animals which do not reach the required standard. Moreover, since a long time is required to see the results of such a policy and there is a natural tendency of individual breeders to repeat breeding experiments—in spite of previous failures of which they may not be aware—it is necessary to emphasise as strongly as possible that systematic improvement of the best indigenous breeds of Indian cattle is the only practicable policy for the generality of the people.

Breeding under Government control

It seems generally agreed also that in India it is essential to make provision for organised breeding control in the villages, and that in all breeding under Government control a definite long-range policy for improving local breeds should be laid down and suitable provision made to ensure that it shall not be changed, except after full consideration of all the issues involved.

Such a matter, in which irreparable harm may easily be done, should not in short be left to the personal predilection of a director who, in present circumstances, may not be a specialist in any branch of animal husbandry or devoted solely to the interests of live-stock. Moreover, seeing that it is an impossibility to produce on Government farms the very large numbers of pedigree bulls which are required for mass improvement of cattle, it seems that the ordinary provincial cattle farm of limited extent should as a rule be utilised primarily for preserving outstanding strains of the best indigenous breeds and for the systematic development and recording of pedigree milch animals rather than in attempting to produce dual-purpose stock.

It is agreed that for the improvement of the generality of stock of a Province or State reliance must be placed upon systematic breeding control in the villages, at first concentrated in areas where the best cattle exist, and later extended, as circumstances permit, into less forward areas. As time goes on and a type becomes established, good animals from selected stock should be registered as pure-bred, while all inferior males should be castrated and the services of approved bulls

recorded. In the case of dairy cattle, strict recording of milk yields is necessary wherever possible in order that, in course of time, breeders wishing to purchase high-grade dairy stock may be able to obtain reasonably accurate data as to the performance of their ancestors. Indeed, the lack of bulls of known pedigree has been one of the greatest difficulties encountered in carrying out the campaign of live-stock improvement instituted by the present Viceroy.

Inoculation and castration

Simultaneously with and complementary to selected breeding along the above lines it is essential to make arrangements for protective inoculation against contagious disease ; while the systematic castration of inferior males, before they can perpetuate the species, is obviously one of the most potent factors in any programme of live-stock improvement. It is in fact now generally recommended that Provincial or State legislation should be undertaken for compulsory castration in selected areas.

At the second meeting of the Animal Husbandry Wing of the Board of Agriculture, held in December 1936, this matter was discussed and it was decided to recommend that such legislation should be of a permissive nature and confined at first to small selective areas which could gradually be extended. But it was felt that the greatest tact would in any case be needed in the administration of such an act.

Grazing control and fodder production and conservation

In present circumstances the main factor in the production of moderate-priced work-cattle is the availability of suitable grazing, since fodder crops are seldom specially grown for such stock. Experience has, however, shown that to rear and maintain the more valuable grades of stock, whether for work or milk production, it is necessary to make provision for an adequate supply of fodder crops or other highly-nutritious cattle-food ; depending on whether the young stock are sold at an early age, to be reared by cultivators under semi-stall-fed conditions, or are reared by the dealer with his nomadic herd. In either case it is necessary that some succulent food of suitable composition shall be available throughout the year, particularly for young stock, but also for breeding females.

The best means of providing such a diet is a matter for local study, but when the revenue obtainable from forests is compared with that from high-grade stock, reared at least partly on cultivated fodder or semi-fodder crops, specially grown to supplement or replace the available grazing, it seem sclear that it will pay Provincial and State governments to give every facility for the production of such crops in areas which are at present under forest of low value.

To deal with this question adequately it seems essential that special committees should be formed as soon as possible on the lines which were recommended by the Animal Husbandry Wing of the Board of Agriculture at its second meeting, held in

Madras in December 1936, after discussing the Report of the Special Forest Grazing Committee, which met during the previous week.

Such committees should obviously be thoroughly representative of all live-stock interests as well as the interests of forestry and crop production, and if on a permanent basis should be able to develop a co-ordinated long-range policy in such matters as the control of forest and other grazing ; the devotion of more land to fodder and semi-crop production ; the conservation of grass and other fodder as hay or silage, and to advise as to possible measures to restrict the numbers of uneconomic cattle which at present overcrowd the available grazing, and are an ever-present source of infection.

Disease control, feeding and management

It must never be overlooked that correct feeding and proper management are most important in securing lasting improvement of stock. But it is now very clear from the work of veterinary investigation officers that expert investigation will constantly be needed of the myriad problems of disease, ill-health and unsatisfactory development due to faulty nutrition ; the proper study of which entails continual veterinary and animal nutrition investigation and research carried out in collaboration.

At present breeders suffer even more from insidious loss due to parasites or nutritional deficiencies than from outbreaks of the major plagues of stock, for some of the most important of which improved and cheap methods of control have recently become available. It seems clear, therefore, that in a country like India where a stamping out policy is impracticable and there is constant danger of infection, adequate staff should be provided for the continuous field investigation of such problems all over the country, in collaboration with veterinary and animal nutrition research workers. This would be in addition to the ordinary provincial veterinary staff which is required for the prompt control of epizootics and the treatment of sick animals, as well as for routine work such as systematic preventive inoculation and castration and the inspection of markets, fairs, abattoirs and dairies.

Marketing

Marketing is another general factor which has immense potentialities in the improvement of live-stock.

Indeed, it is obvious that unless and until satisfactory markets are provided, for improved live-stock and live-stock products, few stock-owners can afford to spend money on the improvement of stock. On the other hand, there is ample evidence that the establishment of a satisfactory market, *e.g.*, for milk or eggs, in any locality, immediately gives a great impetus to the better care and development of the class or stock concerned.

More detailed conclusions of certain live-stock committees which have been formed from time to time to consider measures for the improvement of live-stock are given in the Appendix.

General conclusions

Thus it seems clear that more adequate provision is necessary, in most Provinces and States, for the systematic development of live stock and animal industry

Moreover, it is generally agreed by all authorities on human diet that a more adequate and better supply of milk is an outstanding need of India today—better not only as regards cleanliness, but also in its content of protein and mineral salts which are now recognised to be of first rate dietetic importance ; particularly for growing children and in a diet which is otherwise mainly vegetarian.

It has in fact recently been shown, by practical feeding tests in India and in all progressive countries, that nothing can replace the protein, of high biological value, and the mineral salts which are contained in undiluted milk.

To ensure a better supply of milk it is necessary however (1) to provide for proper control of the marketing of this vital commodity—which at present is usually sold by insanitary, unscrupulous and inadequately controlled hawkers, (2) to produce better milch animals, (3) to furnish better facilities to enable the milk required for cities to be produced in suitable areas outside city limits, and brought in for sale under satisfactory sanitary conditions, (4) to make better provision for milk produced in the villages throughout the country, to be collected at suitable centres, and, after suitable processing, to be marketed as such or in the form of ghee, cream, etc., and (5) to make use of skimmed milk to the fullest possible extent, in human diet and particularly in the feeding of growing children, since in it is contained the whole of the most valuable dietetic constituents of milk, *viz.*, the body-building proteins and mineral salts.

At present, in many parts of India, the she-buffalo is for a variety of reasons preferred to the cow as a milch animal, but it would not be practicable in any event to provide from buffaloes alone, the greatly increased supply of milk which is needed. Moreover, there are points of considerable dietetic importance in this connection which should not be overlooked, *viz.*, owing to its very high though variable butter-fat content, undiluted buffalo's milk is not usually suitable for human consumption. To make it suitable it needs to have fifty per cent or more of the cream removed and, since undiluted cow's and buffalo's milk have about the same percentage of protein and mineral salts, if both are watered down to a suitable level of butter-fat (say 3·5 per cent), buffalo's milk becomes of much less feeding value, particularly for growing children, because the protein and salts thereby become much more heavily diluted.

Thus, while nothing must be done to interfere with the production of useful work-cattle, it appears that the production of more and better milch cattle is a matter of great importance and urgency for the welfare of the people of India.

But to make satisfactory progress and to provide really efficient milkers, it will be necessary to concentrate on high milk production in particular strains regardless of what the effect may eventually be on the capacity for work of the bullocks bred from these particular strains.

The existing supply of working type cattle should in fact be more than ample if young stock and breeding females were better fed, but there is a great shortage of efficient milch cows all over India. On the other hand, it is now well known that there are pure Indian breeds of cattle which have good latent capacity for milk production and which respond readily and markedly to better feeding and management—much more so than buffaloes.

It seems clear, therefore, that the systematic development of high-yielding milch strains of suitable Indian breeds of cattle, as well as of buffaloes for ghee production, is a matter of great urgency and importance to India.

Owing to the high biological value of eggs in human diet, the development of poultry by systematic encouragement of pedigree breeding of selected European breeds, is another matter of great dietetic and economic importance to which far more attention needs to be given as a cottage industry.

APPENDIX

The question of live-stock improvement, with special reference to the pedigree bull scheme initiated by H. E. the Viceroy, was discussed in detail first by the Standing Cattle Breeding Committee of the Advisory Board of the Imperial Council of Agricultural Research held at Simla in July 1936 and then by the Live-stock Improvement Committee of the Second Animal Husbandry Wing meeting of the Board of Agriculture and Animal Husbandry in India held at Madras in December 1936. The following are the conclusions and recommendations arrived at by these Committees :—

1. In order to effect cattle improvement on a broad scale it is necessary greatly to extend controlled breeding in areas where definite types exist and that subsequently as large numbers as possible of selected bulls from these areas should be employed in areas where at present there is no definite type.

2. Where the cattle of an area are sufficiently pure the recording of approved stock in official herd-books should be taken up provincially. Such recording would be quite distinct from the official registration of pedigree stock of dairy breeds of all-India importance which is now being taken up by the Imperial Council of Agricultural Research.

3. In order to ensure a continuous supply of pedigree or approved bulls it is necessary to establish pedigree breeding in selected areas.

4. In order to carry on continuous improvement it is necessary to record accurately the services of all approved bulls and to register their accredited progeny. For this purpose it is necessary to employ extra staff at the rate of one suitably qualified inspector and subordinate staff per fifty bulls.

5. It is not possible at present to carry out strict registration of pedigree stock under village conditions of breeding, nor to undertake milk recording in villages without special staff.

6. It is felt that a great deal of good could be done if the herds maintained in jails, mental hospitals, etc., at Government expense, and at Pinjrapoles were more extensively utilised for the breeding of pedigree stock, and at such institutions strict milk recording should be feasible. It was also suggested that inducement might be given to the Military Dairy Farms to rear the best of their young male stock of indigenous breeds and to suit their breeding policy as far as practicable to the accepted policy of the country, *i.e.*, the improvement of indigenous breeds. It was also suggested that small herds of pure-bred indigenous dairy cattle should be maintained at Government Seed and Demonstration Farms.

7. For the maintenance of bulls it is necessary to establish funds the proceeds of which should be spent partly for the purpose of bulls and partly for their maintenance.

8. Wherever bulls are provided by Provincial or District Cattle Breeding Associations it is essential that provision be made from the same source for their maintenance. Otherwise it may not be possible to accept them.

9. Arrangements should be made for the castration of inferior stock in areas where approved bulls are at work. In regard to compulsory castration it was decided that an enabling Act would be an advantage in most Provinces and States, but that it would be very necessary to exercise tact in its application. It could only be applied where the great majority of breeders were agreeable and where arrangements could be made to supply an adequate number of suitable bulls to serve the cows in the area concerned.

10. Interest of the ryot in cattle improvement should be aroused by such measures as periodical cattle shows and the award of prizes and *sanads* to those who had taken special interest in cattle breeding. Provincial or State Cattle Breeding Societies would also help to arouse interest in cattle improvement but it was considered that such societies need be formed only where satisfactory breeding control does not already exist.

11. In order to encourage people to take interest in pedigree stock it is advisable to give permanent protection against rinderpest to all registered stock free of cost.

12. For the present, services of approved bulls should, as a rule, be given free of cost, but in certain provinces the system of charging fees should be developed.

THE INCIDENCE AND CONTROL OF TRYPANOSOMIASIS AMONG DOMESTICATED ANIMALS IN INDIA*

BY

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INTRODUCTION

AMONG the parasitic diseases which have received the attention of successive veterinary workers in India, trypanosomiasis is, perhaps, the most important. It refers to a group of acute or chronic infectious diseases of man and animals due to the invasion of the body by unicellular blood parasites called trypanosomes. These diseases are generally characterised by intermittent fever and progressive emaciation.

The trypanosomes belong to the flagellate class of the lowest order of animal kingdom, *viz.*, protozoa (Fig. 1). They are eelshaped and are large compared to other unicellular micro-organisms which may be found in the blood such as bacteria, or the piroplasms of tick fever. A special scale known as the micron (μ) is in use for linear measurements in micro-biology. It represents 1/1000 of a m.m. Measured in that scale, they are 21 to 35μ in length (or about the diameter of three to five red-blood-corpuscles) and $1\frac{1}{2}$ to 3μ in breadth. They are more or less blunt posteriorly, pointed anteriorly and are provided with a centrally placed large nucleus and a smaller mass of shining chromatin termed the centrosome or kinetoplast close to the posterior end. The nucleus is the most vital part of the organism and may loosely be compared to the brain of the higher animals. It

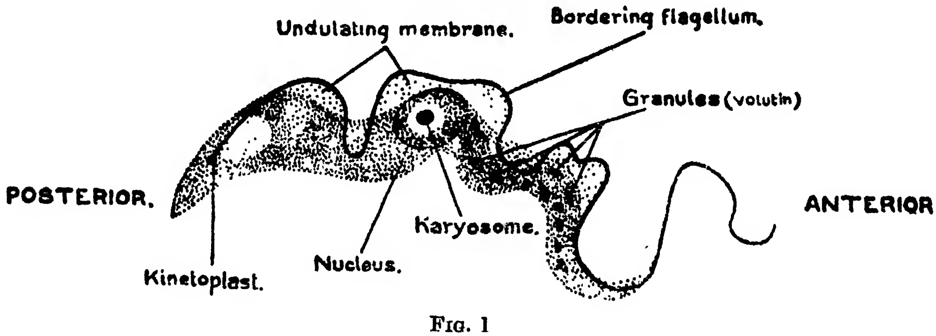

FIG. 1

* This is the sixth of a series of popular articles for practical farmers on various animal husbandry subjects of general interest.

controls all the functions of the organism. The centrosome or the kinetoplast appears to be primarily concerned in the locomotion and reproduction of the parasite. A wavy membranous structure, termed the undulating membrane, commences at the centrosome and runs along the protoplasmic body. Its border appears thickened and is prolonged anteriorly into a whip-like process, constituting the flagellum. The undulating membrane and the free flagellum may be compared in function to the fins of the fish and it is to these the snake-like movements of the parasites are due.

The parasites are large enough to be seen in fresh preparations under a one-sixth inch objective of a microscope. A drop of blood is obtained from a clean sharp prick or a small incision at the tip of the ear. It is placed between a glass slide and a cover slip for examination. If the parasites are present, a disturbance among the red-blood-corpuscles attracts one's attention. If the film has not been too thick, the individual parasites may be seen darting or wriggling among the red-blood-corpuscles.

Probably the only type of multiplication that the parasite undergoes in the body of its vertebrate host is that of division by fission. This takes place longitudinally. The centrosome divides first, then the flagellum and nucleus and lastly the plasma body. Besides this simple mode of multiplication, a sexual propagation, or a special developmental cycle is considered possible in the transmitting insects which act as intermediary hosts, and this takes place first in the digestive tract and later in the salivary secretion.

Of the several species of trypanosomes, the one causing disease in India is *Trypanosoma evansi*. The other pathogenic species of trypanosomes are not commonly known to occur in India, but it may be of interest to the general reader if a brief reference is made to the diseases caused by some of them. These are :

(1) Dourine due to infection with *T. equiperdum*. It has been known to affect horses and asses in some parts of Europe, Morocco, Algeria, Tripoli, United States of America, Asia Minor, Persia and India. It is a venereal disease of breeding animals, characterised, at first by inflammation of the external genital organs. Infection occurs through coitus. At one time prevalent in India, the disease has now been brought to extinction in this country through the provisions of the Dourine Act of 1910 and the efforts of the veterinary authorities.

(2) Nagana or tsetse fly disease due to one or more of the trypanosomes :— *T. brucei*, *T. congolense* and *T. vivax*.

This affects equines and cattle in Zululand, Gambia, and the Congo. It is in this disease that the parasite undergoes the developmental cycle already referred to in the transmitting fly. In common with other trypanosome infections such as those enumerated below, intermittent fever and progressive emaciation are the more prominent symptoms in this disease,

(3) Mal de Caderas due to infection with *T. equinum*. This is a disease of horses and asses in South America.

(4) Gall sickness due to infection with *T. theileri*. This occurs in cattle in Transvaal. This species occurs in cattle in several parts of India, but is usually considered to be non-pathogenic in them.

(5) Sleeping sickness due to infection with *T. gambiense* and *T. rhodesiense*.

This is a disease of human beings in Western and Central Africa.

The morphology of the causal organisms occurring in the different diseases varies somewhat in each case, these varieties being capable of being differentiated only by experts.

The incidence and distribution of surra

Those cases of trypanosomiasis in domesticated animals which are caused by *Trypanosoma evansi* in India and elsewhere are known under the collective name of surra. Surra is a Hindi word meaning "rotten". This term was perhaps coined by the camelmen for whom the skin diseases that develop following infection with surra represented a rotten condition. The disease is also known locally in several parts of India as *Pithgaya*, *Purana*, *Tibirsa*, *Sarhgaya* and *Kanahogaya*.

The disease occurs naturally in horses, mules, donkeys, camels, cattle, dogs and elephants. It is very prevalent in the northern parts of India—the North Western Provinces, Punjab, United Provinces, Rajputana and Bengal. It also occurs in Burma and Assam and has frequently been reported from the Deccan and Madras. Outside India it has been known to exist on the shores of the Persian Gulf, Mauritius, French-Indo-China, the Dutch East Indies, Yunnan, Philippine Islands, Egypt, Sudan, Palestine and Southern Russia.

The cause of surra

The parasite responsible for the disease, as already mentioned, is *T. evansi*. This was discovered in the blood of a camel in 1880 by Griffith Evans, an Indian Army Veterinary Officer, and constitutes the first organism to be incriminated as the causal agent of trypanosomiasis in domesticated animals. Compared to the parasite of Nagana, it is somewhat slender, has a longer flagellum, a more pointed posterior part of the body, a smaller proportion of chromatin granules and is comparatively actively motile. It can, however, be definitely identified from other species of trypanosomes only by one possessing a specialist knowledge of the subject.

The mode of infection

The disease may be spread from one animal to another through the agency of a biting fly. This latter, when interrupted during its feed on a surra-infected animal, may complete its meal of blood on a healthy animal and infect it by inoculating some trypanosomes by means of its 'soiled' proboscis. Of the species of

flies known to carry surra, those belonging to the family Tabanidae are by far the most important. These are moderate to large-sized flies of stout-build and are mottled-brown, tawny, or grey in colour, and are popularly known as horse-flies, and in the vernacular as *bara-dhang*, *bil*, and *dhans* (Plate XXIII, fig. 1).

Surra is also believed by some to be transmitted in the same manner through the agency of Stomoxys or stable-flies. Flies of this genus are comparatively small and resemble house-flies, but possess a long proboscis which projects horizontally forward beyond the front part of the head. These frequently breed in horse dung and stable litter impregnated with urine. The eggs of Tabanidae, on the other hand, are usually deposited on the leaves and stems of plants overhanging water or growing in marshy places, the larvæ being found in a variety of moist situations and frequently in collections of water. It, therefore, follows that surra is very liable to be transmitted from animal to animal in marshy lands and their immediate neighbourhood. The rains in northern India occur between the last week of June and the middle of September and Tabanid flies abound about this period, which is therefore known as the 'surra season' in northern India. The surra season varies in other localities according to the incidence of rain in the respective places.

It will be understood from what has been stated above that these flies transmit surra in a mechanical manner, in contrast to the tsetse fly, the transmitting agent of Nagana in East Africa, in which the trypanosomes (*viz. T. brucei*) undergo a cycle of development. It should, therefore, be remembered that when surra-affected animals are suffering from wounds, there is a probability that ordinary non-biting flies may also convey infection from the blood at such wounds to wounds on uninfected animals.

The trypanosomes are obligatory parasites. They are not capable of an independent existence outside the body of certain species of animals that act as their hosts. It is obvious that, if the disease progressed to a fatal issue in all the species of animals susceptible to it, the trypanosome population would be eventually completely wiped out, so that there would be no host left to provide an infective feed for the transmitting flies. The disease would thus become extinct in the locality. It is only when a trypanosome gets adapted to a life in a state of balance with some of its hosts that its continued existence as an obligatory parasite is assured. Such hosts are known as reservoirs of the parasite. The reservoir of surra in India are believed to be cattle, including buffaloes, and camels, for these, especially buffaloes, harbour the surra parasites for long periods without showing any grave symptoms.

Thus, for the endemic existence of surra, a combination of two factors is essential ; (*i*) a reservoir of the virus, and (*ii*) a transmitting agent in the form of a biting fly.

The incubation period

In most infective diseases, a period elapses between the time of infection and the first appearance of symptoms. This is known as the incubation period. This may vary in the case of surra from a few days to two or three weeks.

Fig. 1

Fig. 2

THE SYMPTOMS OF THE DISEASE

(*a*) *In horses and mules.*—The initial symptom following infection is usually trivial in character. Perhaps the only symptom noticed may be an elevation in temperature up to 104 or 106°F. with the concurrent appearance of trypanosomes in the blood stream. or it may also be associated with urticarial eruptions. Such febrile reactions recur periodically with intervening periods of abatement. The symptoms become progressively severe with subsequent relapses. At the time of the second or subsequent relapse, the animal appears more ill. Its pulse is full and frequent. The mucous membrane of the eye is marked by dark-red patches of haemorrhages. There may be haemorrhage also into the anterior chamber of the eye. A watery discharge trickles from the eye and a slight mucus discharge oozes from the nostrials. An oedema sets in, extending from the fetlock to the hock-joint. With further relapses all the above symptoms are intensified. The action of the heart becomes irritable and the pulse very quick and small. The oedema of the leg increases and extends to other dependent parts of the body such as the region of the throat. sheath. belly and breast (Plate XXIII, fig. 2). There is a progressive discolouration of the mucous membranes which later become pronouncedly icteric. The superficial lymph glands are swollen. There is a staggering gait, which develops into paralysis of the hind quarters. The animal remains prostrate and symptoms of respiratory distress follow. There may be albuminuria. Almost invariably the disease results in death. It occurs from one to two months after the onset of the disease, and occasionally from three to four months. Rarely, in very acute cases, death may take place as early as one to two weeks.

In the early stages of the disease the animal does not appear to ail much during the periods of abatement. The animal feeds well, almost voraciously. Nevertheless the animal falls off in condition progressively (Plate XXIII, fig. 3). During the later phases of the disease a certain degree of oedema persists even during the periods of abatement.

(*b*) *In camels.*—The disease may occur in the camel in one of two forms—the acute and more commonly the chronic.

In the acute form the disease runs a fairly rapid course. The affected animals die within a few weeks or months. Old camels are particularly liable to this form of the disease. The animal is noticed to be dull and periodically off-feed. The eyes lose their glittering appearance. At work the animal tires soon. The hump becomes rapidly smaller. Occasionally oedema on the pads and abdomen may be noticed. The most outstanding symptom. however, is the frequent or continued occurrence of paroxysms of fever and the almost continuous presence of trypanosomes in the blood stream. In certain cases cerebral symptoms may set in, the camel having periodic attacks of convulsions.

The chronic form of the disease is the one that is more commonly met with. This form of the disease is usually insidious, the animal presenting no external

symptoms in the initial stages. The animal goes periodically off-feed, and tires soon at work. The marked brightness of the camel's eye is lost. There is sometimes a watery discharge from the eyes. The animal suffers from periodic attacks of fever. At the commencement the interval between the febrile attacks is short, four or more occurring during a month. As time goes on, during the later stages of the disease the febrile attacks progressively decrease in number until they become only occasional and short. The appearance of the trypanosomes in the blood stream corresponds to the febrile attacks. They are more frequently seen during the early stages than in the later stages. As the disease advances, the mucous membranes may become pale and dotted with haemorrhages. Oedema may develop in the dependent parts. They become predisposed to infections of the skin, particularly mange. Condition is lost slowly and progressively. The hump disappears and the thighs fall away. The animal eventually becomes so weak that it is unable to rise from a sitting position. Death supervenes in a variable period of time, usually in several years, from anaemia and debility, or from broncho-pneumonia and oedema of the lungs. Younger animals may escape death with proper care and nursing.

(c) *In cattle.*—In cattle the disease may vary in character from a healthy carrier condition to outbreaks of acute clinical forms. Certain workers have adduced evidence to show that the disease takes a more fatal course in the male stock than in the female.

In the carrier condition, cattle carry the trypanosomes for considerable periods without manifestations of clinical symptoms. If, however, the animal becomes debilitated or comes under the influence of an inter-current infection the parasite may flare up and give rise to a clinical condition.

The acute form occurs often in the nature of an epizootic. Various degrees of severity are met with. In certain forms it is mistaken for anthrax or *Haemorrhagic septicaemia*, until a microscopical examination of the blood has been made (Plate XXIV, fig. 1). In the most virulent form the animal drops down dead while at work. However, the majority of the animals suffer from a train of well-recognised symptoms. The first symptom noticed is dullness, and disinclination to work. This is soon followed by pyrexia, the temperature ranging from 103 to 106°F. or even 107°F. The animal looks sleepy, with semi-closed eyes and leans for support against the wall. The animal may move aimlessly in a circle and fall down from want of balance. In some instances symptoms of weakness in the loins and of abdominal pain may also be noticed. Delirium is almost a constant symptom, and this alternates with symptoms resembling coma. During the stage of delirium the animal dashes against the wall, or if the animal were in a recumbent position, it strikes its head against the floor and kicks about with its hind legs. The breathing becomes stertorous. The eyes remain wide open, and look wild. There is profuse salivation. Urination and defaecation are frequent and involuntary. In the semi-comatose condition that follows, the animal relaxes fully and

FIG. 1. A bullock in the initial stage of an acute attack of surra

FIG. 2. A chronic case of surra in a bullock with impaired vision

(By courtesy of Captain Bachan Singh)

Fig. 1. Hounds suffering from surra spontaneously contracted Their condition of exhaustion and emaciation is well shown (From the *J. Trop. Vet. Sci.* Vol. IV No. 4)

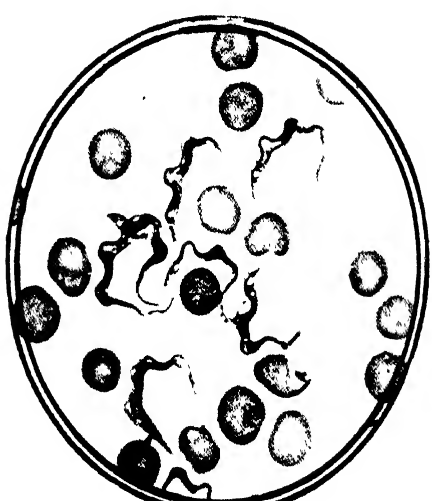

Fig. 2. Microphotograph of *T. evansi* ×1500

remains stretched on the ground. The animal continues to breathe hard. It grinds its teeth, groans, and gulps in air. After a few alternating attacks of delirium and coma, the animal becomes very exhausted and dies. The death takes place, usually after the lapse of six to fifteen hours after the onset of the symptoms, but sometimes it may not occur up to the third or fourth day.

Some observers also recognise a sub-acute form of the disease. It is characterised by a milder course and the duration is stretched over several days or weeks. It somewhat resembles the course that surra runs in the horse. Birefly, the symptoms are those of dullness, intermittent fever, gradual loss of condition, progressive anaemia, tenderness over the loins and back, oedema of the legs, ulcerative keratitis, diarrhoea, prostration and death (Plate XXIV, fig. 2).

(*d*) *In dogs.*—The disease is more fatal in imported hounds than in the pariah dogs. The latter seem to enjoy a certain degree of immunity, for, they are known to harbour the parasite for long periods without coming to a fatal termination Another remarkable fact about the incidence of the disease is that it is more common among sporting hounds kept in a pack than in hounds brought up individually as pets. This fact has led one to suspect that the disease in hounds is acquired from the jackal during a hunt.

The disease may occur occasionally in the acute form. Here the dog dies suddenly after a few attacks of intermittent fever. However, the chronic form is the one that is more commonly met with. The main symptoms of this disease in this form is intermittent fever with progressive emaciation (Plate XXV, Fig. 1). At the initial stage of the disease the dog may not seem to ail much. But as the disease advances, the animal becomes dull and disinclined to take food during the periods of fever. The interval between the attacks of fever gets shorter and shorter. There may be dropsy of the dependent parts of the body. The hair often falls off in patches. A partial or complete blindness may result from clouding of the aqueous humour and opacity of the cornea. The eye-balls themselves appear to sink into the head with consequent protrusion of the nictitating membrane and the mucous membrane of the eye. There is inco-ordination of muscles displayed by a staggering gait. Nervous symptoms in the form of spasmodic twitching of the limbs follow. In some cases this may lead eventually to the complete paralysis of the limbs. Although it is not very common, certain cases have been known to develop cerebral symptoms closely simulating those of furious rabies. The animal then bites the bars of the kennels, does not recognise its attendants and is dangerous to approach. In the advanced stages of the disease many animals run into a comatose condition, in which they appear to sleep quietly. The urine trickles away involuntarily and is viscid and highly coloured. In the majority of cases these periods of coma are interrupted every few hours by a return of the spasms of the limbs, and the animal then makes futile efforts to rise. Death soon takes place, but in every case prior to it the animal regains consciousness for periods

varying from one hour to one or two days. A severe dermatitis, which responds to no ordinary treatment, is a fairly constant complication in the chronic cases.

How to make a diagnosis

The surest means of diagnosis in all the species of animals is the detection of the parasite in blood in a fresh or stained preparation under the microscope during the paroxysms of fever (Plate XXV, fig. 2). The parasites are not very numerous during the later phases of the chronic disease in cattle and the camel. It is then an advantage to sub-inoculate a white mouse or rabbit with a few cubic centimeters of blood of the suspected animal. After the lapse of the incubation period, the parasites will be found to be teeming in the blood of the small animal. In addition a simple chemical test has come to be widely used for the diagnosis of surra in the camel. This is the mercuric chloride test introduced by Bennett in Sudan and it is an easy and efficient test. It consists in adding a drop of serum from the blood of the camel under tests to one c.c. of a solution of 1/25000 of chemically pure mercuric chloride. If the camel is infected, a whitish precipitate develops immediately. In healthy camels the fluid remains clear.

Methods of prevention

The carrier and vector are two factors that are primarily concerned in the spread of surra. With reference to the carrier, one of the provisions in the Glanders and Farcy Act of 1889 provides for the destruction of surra-infected equines. As the real carriers are cattle and camels, this Act does not cover the needs of the situation. With the introduction of the mercuric chloride test camel surra is now capable of being systematically diagnosed and eliminated either by treatment or by destruction of the unprofitable. As cattle, particularly buffaloes, may carry the parasites without showing symptoms and as there is no ready method for the detection of such cases cattle still constitute a danger as carriers. Besides, certain species of wild animals (*viz.*, the jackal) are also suspected to act as carriers. Considering these, it will be realised that the problem of the carrier is one that does not readily lend itself to an easy solution.

The vector is another problem that is also not easily tackled. It has been stated previously that the vectors are frequently confined to low-laying, inundated or irrigated areas, and that they are seasonal in occurrence. Based on these facts, certain recommendations (*viz.*, instituting principles of sound hygiene, avoidance of surra zones, and the use of preventive fly dressings or of light *jhools*) have been made as conducive for the reduction of the risk of infestation with flies. It is obvious, however, that these will not find general application from the point of view of economy and practicability.

The only feasible method of controlling surra, therefore, is by protecting susceptible animals during the surra season by the use of drugs, for no serum or other biological product is known that could be used as a protective against this condition, such as one does for most diseases of bacterial origin. A drug that

can be thoroughly relied upon for the purpose is 'Bayer 205' or Naganol. For convenience, the method of using this drug for the protection of susceptible species of domesticated animals will be dealt with at the end of the section on treatment.

The treatment of surra

(*a*) *In horses and mules.*—Various drugs have been tried during the past thirty years in the treatment of surra. At last a specific has now been found in 'Bayer 205'. 'Bayer 205' or Naganol is a proprietary compound and is believed to be a derivative of aniline dyes and to be free from arsenic. This drug has been synthesised and placed on the market by the Havero Trading Co., Ltd., and is obtainable from their branch at United India Buildings, Chittaranjan Avenue, Calcutta, at about one rupee per gramme. Dr. Edwards, who first introduced this drug for treatment of surra in India, recommended a combined intravenous-intrathecal method of administering this drug. This recommendation was based upon certain experimental observations which seemed to point to the conclusion that the drug, when introduced into the circulating blood alone, was incapable of affecting such of the parasites as had made their way into the cerebro-spinal canal of the infected animal. The results of more recent trials under laboratory conditions as also the experience of field veterinary workers in India and Burma have shown, however, that unless the animal concerned is already in an advanced stage of the disease with symptoms of nervous involvement (in which event drug intervention is hardly likely to be of any avail) intravenous medication alone is usually sufficient for the purpose of effecting a cure. The injection is given in the usual way into the jugular vein by means of a well-sterilized hypodermic syringe. The drug is used as a ten per cent solution in water and a safe therapeutic dose has been found to be five grammes, *i.e.* fifty c. c. of the solution per 1000 lb. body-weight. The solution is made by gradually adding clean, well-boiled water on to the requisite quantity of the powder.

A single intravenous injection as a rule effects a cure, but in order to reinforce the curative effects of the treatment, it is advisable to give a second injection of the drug after an interval of thirty days.

(*b*) *In camels.*—A single intravenous injection alone of forty c. c. of a ten per cent solution has proved successful in curing most cases of surra in camels.

(*c*) *In cattle.*—Cattle may be treated with the intravenous injection of fifty c. c. of a two per cent solution of tartar emetic. This treatment does not bring about a complete sterilization of the system of the parasites. The trypanosomes may persist thereafter in a latent state of activity apparently indefinitely. There are besides other drawbacks attached to the use of tartar emetic. In cases that are heavily infected with trypanosomes, the administration of the drug is immediately followed by acute symptoms of asphyxia and death. Other cases may suffer from a mild degree of discomfort. In certain percentage of cases small quantities of the drug get into the subcutaneous tissue and cause sloughing.

Naganol has none of these drawbacks. Given intravenously, in doses of five c. c. per 100 lb. body-weight of a ten per cent solution, it is a reliable curative.

(*d*) *In dogs.*—As is other animals, Naganol is an efficient curative also in the dog. The dosage recommended is half a gramme in a ten per cent solution to be repeated after an interval of three weeks.

As already mentioned ' Bayer 205 ' or Naganol can also be used as a reliable prophylactic against surra in all species of susceptible animals. The essential merit of this drug from this point of view lies in the fact that it has a large molecule, is therefore slowly excreted, and consequently remains in trypanocidal concentration for long periods in the blood streams. Healthy animals that are exposed to the risk of infection in surra zone can be protected by the intravenous administration of this drug in suitable quantities. The inoculation is to be repeated at suitable intervals until the risk is over. Six weeks has been found to be a safe interval, but this may be prolonged to eight weeks without much risk. It is usual to administer the drug in the same concentration as that used for treatment, *i.e.* as a ten per cent solution. For the horse, camel, and cattle a dose of four c. c. per 100 lb. body-weight will be found to be quite suitable. For the dog a dose of $2\frac{1}{2}$ to 5 c. c. may be given according to the size of the animal.

With the introduction of a successful method of treatment the danger attached to surra from the point of view of the health of live-stock has become considerably lessened. Certain provisions of the Glanders and Farcy Act of 1889 have therefore been relaxed in certain provinces, so that option is given to the owner to have his animal treated in preference to destruction. As a further encouragement to the owner, treatment is given in some provinces free of cost and in others for the actual cost of the drugs. Now that the method has been so simplified, it is within the competence of every Veterinary Surgeon to undertake the treatment of surra. It is therefore up to stock-owners to take advantage of the methods that are now available for the control and cure of surra.

FIG. 1. A typical surface runner of *hariali* grass in Dharwar medium soil

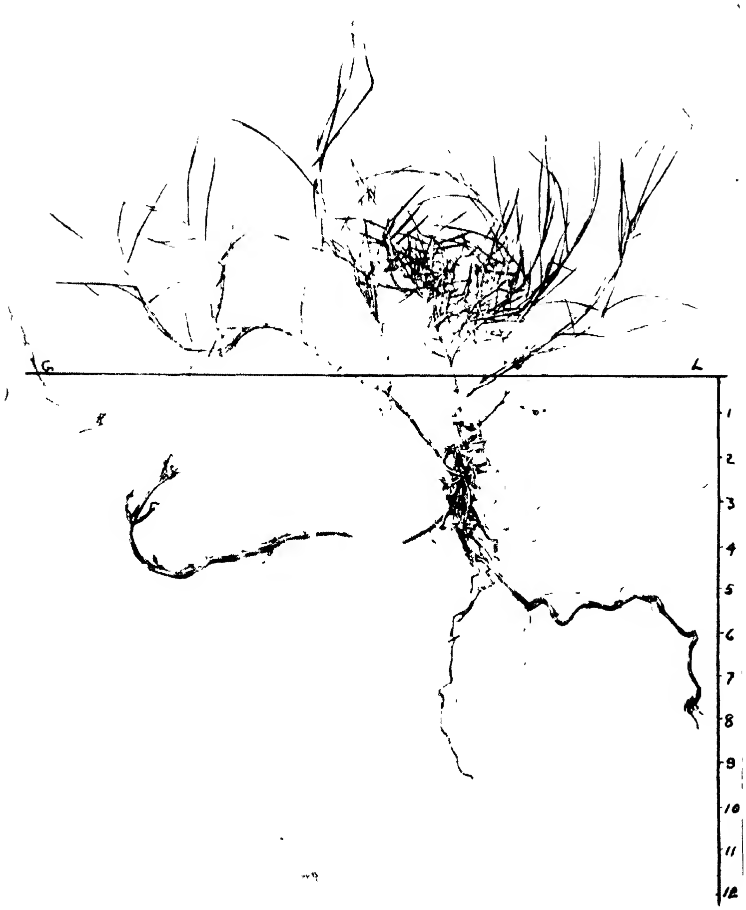

FIG. 2. Runners and rootlets of *hariali* grass in Dharwar medium soil (Red mixed). Depth of vertical runner 8 in., horizontal runner 5 in.

ERADICATION OF *CYNODON DACTYLON* (*HARIALI*-DOUB GRASS) BY TRACTOR PLOUGHING IN THE BOMBAY-KARNATAK

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I. INTRODUCTION

CYNODON DACTYLON, called *hariali* in Marathi or *kariki* in Kanarese, is a common grass much in favour as a horse-feed and for making lawns. In the field, however, it is a persistent and troublesome weed.

In general habits it is a xerophyte and has the usual adaptations to enable it to tide over long dry spells in the year. Its surface parts are more or less glaucous. The leaves are crowded and have nyctinastic movements. Its above-ground stem trails close to the soil (Plate XXVI, fig. 1) and it possesses numerous succulent underground runners (Plate XXVI, fig. 2). The majority of the latter are distributed within a few inches below the soil surface but a few go deeper. The latter are locally known as *kuni-beru* or *tai-beru* meaning thereby 'deep going' or 'mother runners' (Plate XXVII, fig. 1). All runners have numerous nodes capable of sending out fresh shoots and roots under suitable moisture conditions.

On account of these characteristics, once the weed is established, neither the annual cracking of the black soil nor the usual shallow cultural operations are able to exercise any material check on its rapid spread. Its thick network of runners practically starves out the crops and vast areas of good fertile land are rendered unfit for any profitable cultivation.

The usual method in vogue for eradicating this grass is to dig it out by manual labour. This method is, however, very slow in progress and prohibitive in cost. It costs on an average Rs. 30 to 40 to dig out the grass in one acre in a thickly-infected field. In the present days of depression very few landlords are able to do this and the area affected by this weed is increasing annually.

Ploughing up the *hariali*-ridden land and exposing the runners to dry up and die in the sun is a more convenient method. In this direction bullock-drawn iron ploughs, the Bajac Gear Plough and the Steam Plough were all tried in past years but with limited success. With the introduction of high-powered tractors and deep ploughs the problem again seemed possible of an economic solution. The Karnatak Agricultural and Transport Company, Hubli, under Mr. M. P. Fletcher, have been executing contract ploughing at fairly economic rates. In the absence of a Government tractor unit, the present investigation was undertaken in fields ploughed by the above-named firm who readily co-operated with us as far as possible.

As fields had to be selected from amongst those that happened to be ploughed by the firm, a certain amount of irregularity in intervals between observations and in the number of fields of each type of soil studied was inevitable. Moreover, as this investigation was to be conducted in fields situated far in the interior, away from any central research station or laboratory, a very simple technique had to be followed. Randomisation was not possible and in many cases individual samples had to be relied upon. Under these circumstances, it is not claimed that the investigation as conducted was statistically significant but it is hoped that the great care taken in arriving at the attainable data will give fair indications of practical value.

II. The tract and soils concerned and a description of the fields under observation

The tract where the *hariali* problem has been very acute is the 'dry tract' or what is known as the *Yeri-nad* of the southern part of the Bombay Presidency. In this area four types of soil are met with, *viz.* :—

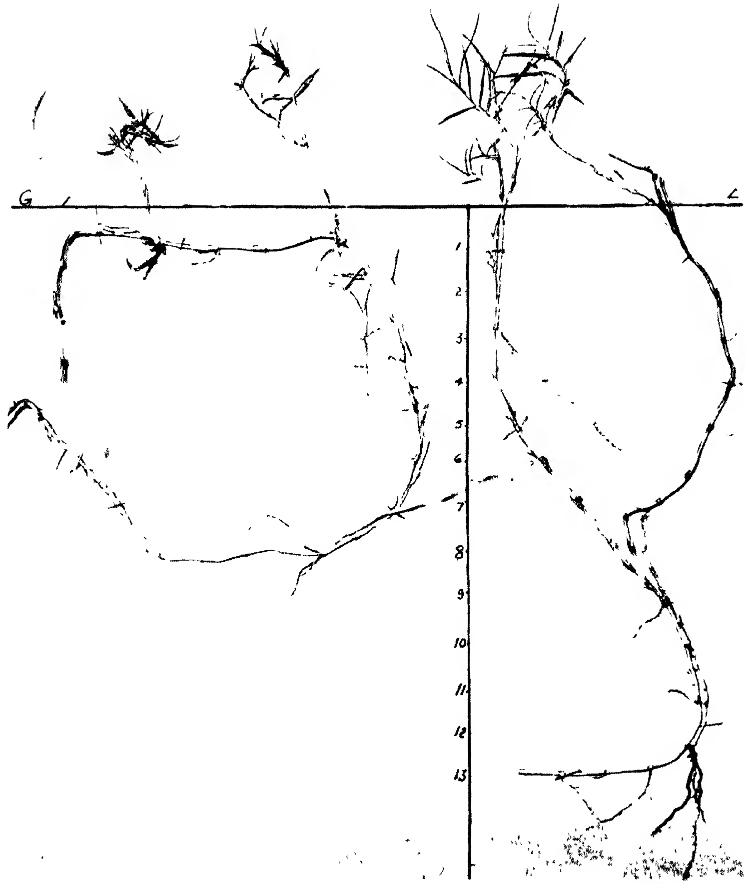
I. The typical black cotton soil which is heavy clay.

II. Black soil mixed with a fair amount of silt brought down from higher levels and deposited during its movement towards the adjoining *nallas* (water-courses) and named in this article as '*nalla*-side black soil'.

III. Low-lying alkaline (*karl*) soil which gets some silt washed down from higher levels.

IV. Average *karl* soil without any possibility of getting any silt or washing from higher levels.

About 80 per cent of the area in this tract is of Type I and about 10-15 per cent is of Type IV. The other types are found in comparatively small blocks of land distributed over the entire tract. Incidentally, as things permitted, a fifth type, *viz.*, the medium soil situated near Dharwar in the 'transition tract' was dealt with. This is shallow soil (only about a foot or so deep) and less clayey than soils in the 'dry tract.'



Dharwar medium soil—field No. 10 Good black cotton soil—field No. 4

FIG. 1. Horizontal and straight going runners

A few fields thickly infested with *hariali* were selected in the above types of soil. The previous history of the same is given in brief below to facilitate understanding of the data dealt with later.

I. *Good black cotton soil*

Field No. 1 . . Fallow in 1933-34 and 1934-35 ; cotton sown in 1935-36 but crop failed to give any yield due to *hariali* infestation. Cultivated by tenants only.

Field No. 2 . . Wheat in 1934-35, yield very low due to *hariali* infestation ; fallow in 1935-36 due to the same cause. Cultivated by tenants only.

Field No. 3 . . Wheat in 1934-35, low yield due to *hariali* infestation ; *jowar* in 1935-36, crop failed due to same cause. Cultivated all along by owner. Deeper and heavier clay than the others, and is different from others in this characteristic. Level field.

Field No. 4 . . Wheat in 1934-35 and cotton in 1935-36, both gave very low yields due to *hariali* infestation. Cultivated all along by tenants only. Level field.

II. Nalla-*side black soil*

Field No. 5 . . Cotton in 1933-34, *jowar*, gram and safflower in 1934-35, wheat in 1935-36, all very low yields due to *hariali* infestation. Subject to occasional mild flooding by adjacent water course (*nalla*). Cultivated by owner.

Field No. 6 . . *Jowar* in 1934-35, very low yield, fallow in 1935-36 due to *hariali* infestation. Subject to mild flow of large volume of water from large catchment area ; has two big *nallas* along its boundaries. Cultivated by tenants only. Neglected field.

III. *Low-lying* karl *soil*

Field No. 7 . . Wheat in 1933-34, *jowar* in 1934-35, cotton in 1935-36, all very low yields due to *hariali* infestation. Subject to mild flow of large volume of water from catchment area but not subject to flooding from adjacent *nalla*. Cultivated by owner.

IV. *Average high-lying* karl *soil*

Field No. 8 . . Wheat in 1934-35, cotton in 1935-36, both no yields due to *hariali* infestation. Cultivated by tenants only.

V. *Dharwar medium soil*

Field No. 9 . . *Jowar*, niger, wheat, gram, and inferior millets in different portions in 1934-35 ; *jowar*, wheat, and inferior millets in 1935-36. In both years poor yields due to *hariali* infestation. Cultivated indifferently by tenants only

F

Field No. 10 . *Jowar* in major portion and chillies on small area in 1934-35 ; in 1935-36 *jowar* in most area and *udid*, brinjals and gram on small areas. Cultivated by tenants only in an indifferent way. Situated close to Dharwar town limits. Thick *hariali* infestation and low yields. Got a light shower soon after ploughing.

Field No. 11 . Gram in 1934-35 ; *jowar* in most of the area and brinjals in the rest. Poor yields due to *hariali* infestation. Situated close to Dharwar town limits. Cultivated by tenants only in an indifferent way. This field got a light shower of rain a few days before ploughing.

III. Extent of *hariali* infestation

In each field, a preliminary eye-estimate of the general spread of *hariali* was made and then the above-ground shoots were counted in nine square feet in an infested portion of the field and the same calculated per square foot. Similarly the depth to which the underground runners penetrated the soil was ascertained in ten test pits in each field. The depth at which the horizontal runners were found and the maximum depth to which the *kuni-beru* (deeper-going runners) penetrated the soil were carefully noted. A summary of these observations is given in Table I.

Table I

Type of soil and serial number of field	Extent of surface stand of *hariali*		Depth of underground runners		Remarks
	Eye-estimate of the *hariali* infestation in whole field (per cent)	Number of *hariali* shoots seen on surface per sq. foot *	Depth of spread of horizontal underground runners (inches) **	Depth of penetration of deep-going runners (*kuni-beru*) (inches) **	
1. *Good black cotton soil*					
Field No. 1 . .	90	5·66	6·8	12·0	*Average of nine square feet
Field No. 2 . .	80	4·44	5·6	11·7	
Field No. 3 . .	60	3·88	5·2	10·7	
Field No. 4 . .	80	3·33	5·7	13·4	
Average .	..	4·33	5·8	12·0	**Average of ten test pits

TABLE I—*contd.*

Type of soil and serial number of field	Extent of surface stand of *hariali*		Depth of underground runners		Remarks
	Eye-estimate of the *hariali* infestation in whole field (per cent)	Number of *hariali* shoots seen on surface per sq. foot *	Depth of spread of horizontal underground runners (inches) **	Depth of penetration of deep-going runners (*kuni-beru*) (inches) **	
II. Nalla-*side black soil*					
Field No. 5 . .	75	5·66	9·2	25·5	
Field No. 6 . .	80	3·88	8·5	28·0	
Average .	..	4·77	8·85	26·7	
III. *Low-lying* karl (*alkaline*) *soil*					
Field No. 7 . .	80	4·66	7·2	14·9	
IV. *Average* karl (*alkaline*) *soil*					
Field No. 8 . .	90	4·44	4·7	10·9	
V. *Dharwar medium soil*					
Field No. 9 . .	80	4·44	4·3	7·9	
Field No. 10 . .	75	5·0	4·2	8·6	
Field No. 11 . .	75	5·0	5·0	9·8	
Average .	..	4·81	4·5	8·8	

The above data indicate that—

(*i*) Thick infestation means about four to five above-ground shoots of *hariali* per square foot of land and when this condition exists over about 75 per cent or more of a field the land becomes unable to give economic crop yields and is often not cropped at all.

(*ii*) The depth to which the *kuni-beru* (deep-going runners) penetrate the soil varies in different soils. In good black cotton soil it averages 12 inches and goes even up to 13½ inches in a few fields. In the average *karl* soil and in the Dharwar medium soil it does not seem to go deeper than 11 inches, whereas in fields situated by the side of *nallas* it may extend as far down as 28 inches in good alluvial black soil and about 15 inches in alkaline black soil similarly situated.

(*iii*) The ***kuni-beru*** were few and scattered. Most of the underground runners spread horizontally much nearer the surface, within the top 6 inches in (I), (IV) and (V) Types of soil and up to 8 or 10 inches in *nalla*-side soils of the *karl* or non-*karl* type (Plate XXVII, fig. 2).

(*iv*) Twelve-inch-deep ploughing uproots all the horizontal runners in all types of soil. Similarly with such ploughing most of the *kuni-beru* are exposed in good black cotton soil, only a few escaping in very small lengths below the ploughshare. In the average *karl* and Dharwar medium soils deep ploughing is fully effective but in *nalla*-side fields of either the *karl* or non-*karl* type where the soil is mixed with alluvium to a more or less extent, the situation is not encouraging as here the runners escape below the ploughshare in considerable lengths.

IV. Depth-tests of ploughing

As all further observations were to be done in the soil turned over by the plough, the depth of ploughing was tested at ten places selected at random in each field and the average was arrived at (Table II).

Table II

Type of soil	Serial number of field	Average depth of ploughing (inches)	Average depth of ploughing for each type of soil (inches)
Good black cotton soil . .	1	12·6	12·12
	2	11·6	
	3	11·9	
	4	12·4	
Nalla-side black soil . .	5	12·5	11·95
	6	11·4	
Low-lying *karl* (alkaline) soil .	7	11·9	11·9
Average *karl* soil . . .	8	12·8	12·8
Dharwar medium soil . .	9	11·7	12·10
	10	12·4	
	11	12·2	

It was outside the scope of the present investigation to find out why the depth of ploughing varied, though slightly in different fields, although the tractor and plough and the adjustment of the plough were uniform in all cases. It was enough for our purpose to know that it was a fair twelve inches work. The unit consisted of a 52 B. H. P. Diesel tractor of the Track Type and a Rud Sack Deep Tillage Three-bottom Mould-board Plough. The tractor could pull the plough smoothly in all these fields.

V. Position of *hariali* runners in ploughed land

Ploughing raises the soil into clods and loose soil. The *hariali* runners contained therein are similarly disturbed. In the present investigation it was, therefore, necessary to know the proportion of clods and loose soil so formed and the proportion in which the *hariali* runners remained in clods or in loose soil.

Immediately after ploughing, test pits measuring 3 ft. $\times$ 3 ft. were scraped carefully to the depth of ploughing and clods and loose soil were separately weighed. All lumps of four inches and more in diameter were classed as clods and the rest as loose soil. The *hariali* runners in these were then carefully separated and weighed. The weight of runners in loose soil could thus be directly determined. Those in clods had to be further classified. Some of the latter were entirely imbedded in clods and a few had extensions outside the clod. The actual weighments taken under ' runners in clods ' included both of these and accordingly the proportions of those entirely in clods and the extensions outside the clod had to be estimated as follows : It was presumed that the amounts of *hariali* in the clods and loose soil were roughly proportional to the weights of clods and loose soil in a sample. Therefore any excess in the proportion of the runners in clods in our initial weighments over that of clods to the total weight of the soil was taken to be due to these extensions. It should also be understood that in each test pit the soil and runners were scraped up to the hard pan below the furrow cut by the plough, though the depth of ploughing possibly varied to a slight extent from place to place even in the same field. As such, the data quoted per cubic foot in this chapter represent the same for as much surface area scraped as explained above. This fact, however, should not vitiate the percentage figures worked out thereon as needed in the present case. In each field four to six test pits were examined and the figures so arrived at were averaged for each type of soil (Table III).

TABLE III

Type of soil	Proportion of clods and loose soil in ploughed land (average)						Proportion of *hariali* runners caught in clods and in loose soil in ploughed land (average)						Remarks
	Average weight of clods in 9 c.ft. of ploughed land	Average weight of loose soil in 9 c.ft. of ploughed land	Average weight of 9 c.ft. of soil, including clods and loose soil	Average weight of one c.ft. of ploughed land (including clods and loose soil)	Percentage of soil in clods	Percentage of loose soil	Weight of *hariali* runners entirely imbedded in clods in 9 c.ft. of ploughed soil	Weight of runners extending outside the clods in 9 c.ft. of ploughed soil	Weight of runners in loose soil in 9 c.ft. of ploughed land	Percentage of runners entirely imbedded in clods	Percentage of runners extending outside the clod	Percentage of runners entirely in loose soil	
1	2	3	4	5	6	7	8	9	10	11	12	13	14
	lbs.	lbs.	lbs.	lbs.			grms.	grms.	grms.				
1. Good black cotton soil	224·0	485·0	709·0	78·8	31·59	68·41	13·38	4·71	24·27	31·59	11·13	57·28	All the data were arranged from 4 to 6 tests taken in each field of each type
2. *Nalla*-side black soil	295·4	508·7	844·1	93·8	29·10	70·9	17·01	2·59	32·60	29·10	8·44	62·46	
3. Low-lying *karl* soil	258·0	490·0	748·0	65·5	34·49	65·51	14·26	10·34	17·80	34·49	23·61	41·90	
4 Average *karl* soil	345·0	306·2	651·2	72·36	52·97	47·03	27·0	5·2	18·7	52·97	10·26	37·77	
5. Dharwar medium soil	253·0	475·0	728·0	81·0	34·7	65·3	16·6	5·7	25·6	34·7	11·86	58·44	

The above data indicate as follows :—

(*i*) On an average 32 to 35 per cent of the soil breaks under the plough as clods in all soils, except in the average *karl* soil (Type IV) where clods form more than fifty per cent of the soil. In the *nalla*-side black soil the percentage of clods is the lowest (29 per cent). These figures indicate roughly the physical texture of the ploughed soil of each type, and the facility provided thereby for the rapid drying of the soil and runners contained therein. The *karl* soil shows the optimum response to ploughing in this respect and the *nalla*-side alluvium-mixed black soil the least.

(*ii*) The *hariali* runners are not only held inside the clods but a few of these retain extensions outside the clods. Soils which set hard and have succulent runners (Type III) show more of these extensions and the least is noticed in Type II where the soil is more friable and clods less hard.

(*iii*) In the common good black cotton soil, about 32 per cent of the runners are in clods, about 12 per cent extend outside the clod and about 57 per cent are located in loose soil.

VI. Effect of deep ploughing on the viability of *hariali* runners

The main purpose of our investigation was to know the effect of deep ploughing on the viability of runners and to what extent *hariali* was killed thereby. In this connection, careful simultaneous determinations of the moisture in the clods and loose soil and of moisture in the runners contained therein were undertaken at intervals of about a week and the viability of the runners was also studied. It was not possible to regulate these intervals very rigidly as fields were located rather too far apart. Thus, slight delays in testing the viability in some cases might have shown a longer viability period. This was inevitable.

In Table IV a summary of these data are given for different soils.

TABLE IV

Type of soil and serial number of field	Date of ploughing	Soil moisture: Before ploughing: At 6 in. depth	Soil moisture: Before ploughing: At 12 in. depth	Soil moisture in ploughed land: Just after ploughing: In clods	Soil moisture in ploughed land: Just after ploughing: In loose soil	Soil moisture in ploughed land: When viability ceased: In clods	Soil moisture in ploughed land: When viability ceased: In loose soil	Moisture in runners: Just after ploughing: In clods	Moisture in runners: Just after ploughing: In loose soil	Moisture in runners: When viability ceased: In clods	Moisture in runners: When viability ceased: In loose soil	Index of moisture: Just after ploughing: In clods	Index of moisture: Just after ploughing: In loose soil	Index of moisture: When viability ceased: In clods	Index of moisture: When viability ceased: In loose soil	Period after ploughing when runners lost their viability: In clods	Period after ploughing when runners lost their viability: In loose soil
		Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Days	Days
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
								I. Good black cotton soil									
1	15th February	5·2	9·8	5·8	7·5	2·7	3·6	20·0	21·0	6·0	5·0	3·45	2·80	2·22	1·39	17	17
2	28th February	4·8	8·2	5·7	6·5	1·5	3·45	35·0	35·0	6·0	6·0	6·14	5·38	4·4	1·74	17	17
3	7th March	5·8	13·7	9·2	9·75	3·2	6·0	36·0	36·0	10·0	14·0	3·91	3·69	3·12	2·33	53	30
4	7th March	4·7	9·0	5·5	6·85	2·5	3·75	24·0	24·0	8·0	6·0	4·36	3·50	3·20	1·60	17	29
Average	...	5·1	10·2	6·54	7·65	2·47	4·2	28·7	29·7	7·5	7 7	4·46	3·84	3·23	1·76	26	23
								II. Nalla-side black soil									
5	17th February	3·0	6·3	6·9	4·65	3·7	2·45	40 0	40·0	6·0	8·0	5·79	8·59	1·62	3·28	25	17
6	1st March	4·2	7·3	6·8	5·75	2·2	3·25	20·0	20·8	8·0	6·0	2·94	3·44	2·10	1·71	16	16
Average	...	3·6	6·8	6·85	5 20	2·95	2·85	30·0	30·4	7·0	7·0	4·36	6·01	1·86	2·48	20	16
								III. Low-lying karl *(alkaline) soil*									
7	19th February	6·3	9·5	7·0	7·90	3·7	2·70	22·0	22·0	8·0	6·0	3·14	2·79	2·16	2 22	16	16
								IV. Average karl *(alkaline) soil*									
8	28th February	4·2	11·50	6·5	7·85	2·2	3 25	18·0	18·0	6·0	4·0	2·77	2·29	2·72	1·23	9	9
								V. Dharwar medium soil									
9	8th April	4·0	9·3	7·5	6·65	2·7	3·75	18·0	18·0	4·0	6·0	2·40	2·70	1·48	1·60	19	19
10	14th April	5·5	9·9	7·8	7·70	3·2	4·25	18·0	18·0	4·0	6·0	2·31	2·34	1·25	1·31	20	20
11	25th April	5·9	9·5	7·1	7·70	3·8	3·65	24·0	24·0	6·0	8 0	3·38	3·11	1·59	2·16	28	28
Average	...	5·1	9·5	7·4	7·35	3·2	3·88	20·0	20·0	4·6	6·6	2·69	2·72	1·44	1·69	22	22

The various data given in the above table indicate as follows :—

(*i*) Soils not only vary in the proportion of clods formed in them by the plough but also in their moisture-holding power and consequently in the moisture content and succulence of the *hariali* runners contained therein. Accordingly, *hariali* retains its viability for different periods after ploughing in different soils.

(*ii*) In an undisturbed condition, the *nalla*-side semi-alluvial black soil holds less moisture at twelve inches depth than others. The average *karl* soil shows the highest moisture content at this depth (*vide* col. 4).

(*iii*) When ploughed, the loose or pulverised portion and the clods possess the same amount of soil moisture (*vide* cols. 5 and 6) but by the time of loss of viability of the *hariali* runners the loose mass generally is slightly more moist (about one per cent) than the clods (*vide* cols. 7 and 8).

(*iv*) The total loss of soil-moisture during the viability period is about 4 to 5 per cent in all types of soil (*vide* cols. 5, 6, 7 and 8).

(*v*) The *hariali* runners in good black soil and *nalla*-side black soil are more succulent (29 to 30 per cent moisture) than in any other type of soil. They hold the least quantity of moisture in the average *karl* soil (Type IV).

(*vi*) The viability of the runners in clods as well as in loose soil is lost when the moisture in runners falls down to about 7 per cent in soils I, II and III. This stage is reached in other soils (the average *karl* and the Dharwar medium soils) when the runners show 4 to 6 per cent moisture.

(*vii*) The index of moisture is distinctly low at the time of loss of viability as compared with the same before ploughing in *nalla*-side black soil, and in others this fall is by about one or two degrees only (*vide* cols. 13, 14, 15 and 16).

(*viii*) The total fall in the moisture content of runners whether situated in clods or in loose soil is as much as 21 to 23 per cent in good black soil and in *nalla*-side black soil, and about 14 to 16 per cent in other types of soil. It seems that it is this severe drying of the runners that chiefly kills them (*vide* cols. 9, 10, 11 and 12).

(*ix*) The ploughed-up runners, whether in clods or in loose soil, dry up and loose their viability in about 8 to 10 days after ploughing in the average *karl* soil, and 15 to 16 days in low-lying *karl* soil. In the Dharwar medium soils this period extends to about three weeks and so also in the *nalla*-side alluvium-mixed black soil. In good black soil, the runners appear to lose their viability usually in about 15

to 17 days except in a few owner-cultivated heavy clay fields where this period may extend up to 50 days after ploughing (*vide* cols. 17 and 18). From the above it is clear that clear dry weather for about three weeks after ploughing is sufficient to destroy the viability of the ploughed-up runners in any type of soil. This further indicates that if ploughing for reclamation of *hariali*-ridden lands is to be attempted it should be done only when no rain is expected within three weeks after ploughing. Only in the average *karl* soil a dry period of 8 to 10 days would suffice.

VII. Laboratory experiments regarding viability of *hariali* runners

As a check on the results obtained in our field observations, a few laboratory experiments were undertaken. A few runners were picked at random in a field of each type and exposed for one, two, three, four and five days to the sun and their moisture content as well as their viability was determined. The data obtained are given in Table V wherein the stage at which viability disappeared is marked by an asterisk (*).

TABLE V

Type of soil and serial number of field	Original moisture content of runners when picked	Moisture content of runners after drying them for				
		One day	Two days	Three days	Four days	Five days
I. Good black cotton soil, Field No. 1.	20·0	8·0	5·0*	4·0	2·0	1·0
II. *Nalla*-side black soil, Field No. 5.	40·9	17·0	11·6	8·0*	4·0	2·0
III. Low-lying *karl* soil, Field No. 7.	22·0	12·0	6·0*	3·0	2·0	1·0
IV. Average *karl* soil .	Not tested					
V. Dharwar medium soil, Field No. 9.	18·0	9·0	5·0*	2·0	2·0	Not tested

The above data indicate that there is a sharp fall in the moisture content of runners soon after exposure to the sun. Two days' exposure was enough to kill runners of all soils except those of *nalla*-side black soil due to the high succulence of the latter runners. The data further justify the inference that once the moisture in runners reaches this point, viability is permanently lost and cannot be restored even if optimum moisture conditions recur due to artificial watering or rainfall.

VIII. Conclusions

The present investigation permits of a few conclusions of practical value as follows :—

A. *Nature and extent of the* hariali *problem in the area investigated*—

(*i*) *Hariali* infests all types of soil equally severely. A field which shows four to five shoots of *hariali* per square foot over seventy-five per cent or more of its area is unfit for economic cropping.

(*ii*) In addition to its thick growth on the surface, the *hariali* has a net-work of runners in the soil. These have two zones of spread. Most of them go horizontally within the top six to ten inches of the soil. A few go vertically to greater depths. In the common black cotton soil and in the average *karl* or alkaline soil the maximum penetration of the latter is about twelve inches. In the alluvium-mixed fields situated in low-lying situations or by the side of water-courses (*nallas*) they may penetrate as deep as fifteen to twenty-eight inches or more.

B. *Where tractor-ploughing may be undertaken.*—The above observations indicate that the common black cotton soil and the average *karl* soil have the *hariali* runners within the top twelve inches of the soil and thus offer good results if ploughed to twelve inches depth as is possible with the machine and plough now in use. In the *nalla*-side and similar alluvium-mixed soils they extend far too deep, and when such fields are ploughed a large number of viable runners may escape in great or small lengths below the plough share. The latter thus remain unaffected by the ploughing and will re-sprout as soon as soil-moisture conditions are favourable. In such fields, therefore, tractor-ploughing will be ineffective in removing the *hariali*. Careful hand-digging is the only remedy that can be advised in such cases.

C. *How ploughing kills the* hariali—

(*i*) Ploughing opens up the soil into clods and loose soil and exposes it to the heat of the sun. The clods and loose soil are very loosely mixed up permitting hot air to circulate freely in the inter-spaces. The *hariali* runners are similarly exposed. Consequently the soil and the runners contained therein lose moisture rapidly. Finally a stage is reached when the *hariali* runners lose their viability completely.

(*ii*) This loss of viability occurs when the runners show a fall in their moisture content from 20 to 30 per cent at the time of ploughing to 7 to 4 per cent at the death point.

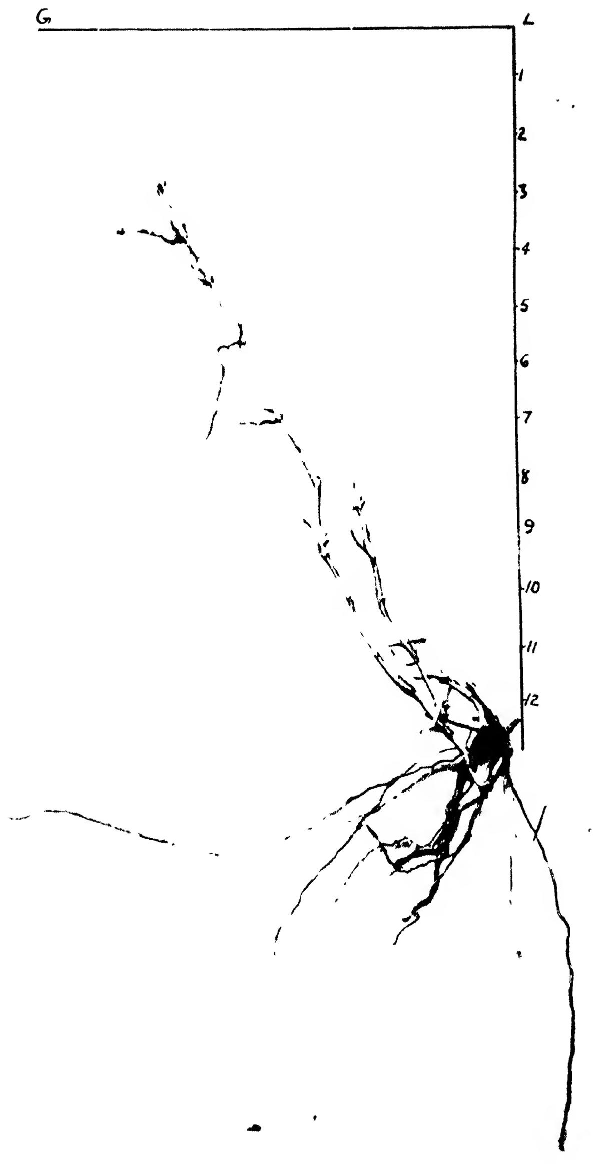
(*iii*) Field observations, supported by laboratory tests make it clear that once the runners dry up to their death point no amount of rain or watering can revive them.

(*iv*) The period of exposure after ploughing needed to force the runners to their death point differs in different soils but is practically the same for runners in clods or in loose soil in all cases. In the average high-lying *karl* soil this period is only eight days. In all other types of soil it is about 15 to 17 days, except in a few well-cultivated fields of heavy clay where this period may extend up to 50 days.

(*v*) Thus, a hot dry weather for about three weeks after ploughing is necessary to destroy the capacity of the ploughed-up runners to re-sprout. This further indicates that if deep ploughing for reclamation of *hariali*-ridden lands is to be attempted it should be done only when no rain is expected within three weeks after ploughing.

D. *General.*—It is a natural habit of this grass to send a few runners very deep into the soil. This fact may result in a few small pieces of viable runners escaping below the plough share even in the black cotton soil. These may re-sprout in the succeeding wet seasons (Plate XXVIII, fig. 1). Care should be taken in all soils to remove this slight re-growth by hand-digging. Any neglect in this direction will bring about a return of the *hariali* though gradually, in about eight to ten years.

PLATE XXVIII



Re-growth of *harali* from a piece of runner left below the furrow (*i.e.* below 12 in.) in a field ploughed on 17th February, 1936 (Photographed on 26th June 1936)

FIG. 1.—Calf-feeding. Training class at work (Group I—calves upto 10 weeks old)

FIG. 2.—Calf-feeding. Training class at work (Group II—calves from 10 weeks to 10 months old)

THE REARING OF PAIL-FED CALVES

BY

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I.—INTRODUCTION

DURING the last two years a number of people have visited the Institute at Pusa to see for themselves the Pusa system of feeding and handling cattle [Sayer, 1934], and in many cases we have subsequently had their herdsmen and supervisors sent to pass through and work at the whole system for themselves and learn exactly what we do and the reasons for the whole process from calf-rearing right up to four times milking. It has become painfully evident from watching the ideas and methods of many of these men that the science of calf-rearing is one of the most neglected sides of milch-cattle breeding, and while Government spends money freely on staff, stock and buildings, it calmly watches money thrown away by ignorance or neglect of ordinary first principles in calf-rearing. The future of every pedigree herd rests on its calves, and if the calf mortality is 40 per cent in any herd, that herd is costing about twice as much as it should to breed quality stock, and a large number of valuable animals bred at a high cost are being lost to Government—the breed and the industry, and worst of all, cattle breeding is being actually taught and demonstrated on some of these farms where such mortalities are common yearly events. In this article, I do not propose to refer to epidemics or to any special calf diseases which require expert veterinary advice and assistance. All that is aimed at here is to give a clear concise account of how to rear an ordinary calf from birth and to keep it in good health and clear from ordinary diseases until it is able to join the young stock paddocks. At Pusa, we had no modern buildings, no special devices or appliances. Our *gowala* staff is probably the lowest paid in India. They have no diplomas and no training except what they have received here, but we have a calf mortality of 1·6 per cent which is the best diploma of all. Our knowledge of cattle is the knowledge obtained from handling and breeding them, and such knowledge is the best in the world. It is no use having a trained staff and wild cattle any more than a wild staff and trained cattle. Make the staff train the cattle until the cattle can almost train the staff.

II.—THE METHOD OF CALF-REARING AND FEEDING

Now successful calf-rearing begins, though it may not be generally realised, long before the birth of the calf. If your cow or heifer is properly trained,

properly handled and properly rationed during pregnancy [Sayer, 1936], you will get a state of things at birth which will give you a healthy calf dropped by a cow who is quite calm, normal and in proper condition. She will have been milked out just before, and her bag will be easy, and this will avoid a lot of trouble.

Calve your cow down in a loose box at least 12 ft. × 12 ft., a box she is used to and has occupied some days previously. Let one man whom she is used to, observe her during calving. The calving box should not be open in front. Directly the calf is out, put a sack over the cow's head and remove the calf. Do this quickly, quietly and efficiently, and it should make no difference if the cow calves at 2 A.M. or 2 P.M. It should be done equally promptly. Most of the cows I have examined that have failed to give down properly have calved about 2 A.M., and the calf has been removed about 6 A.M. by some individual who has just waken up. Don't blame the cow, if she refuses to give down in such cases.

You now have a newly-born wet calf on your hands. Take it to a sheltered place and lay it down on a dry sack ; clean the mouth and nostrils first, and rub the body quite dry with an old soft sack. Trim the navel cord to half an inch and paint it with tincture of iodine, continuing this treatment for 4 or 5 days till the cord dries up. It is quite unnecessary to tie the navel cord with a string as is so frequently done. While the calf is being dried, put your fingers in its mouth (your hand should be clean and the nails pared close) and train it to suck. This is most important, as when the calf comes to suck milk from the pail later, it will do it naturally from your fingers. Never wash a new born calf ; imitate its mother : she licks it dry, and the old sack will do the job perfectly. When the calf is able to move about freely, which will be about an hour after birth, give it half a pound of colostrum. Four hours later it can be brought over to the general course of feeding.

Colostrum from the dam or any other cow calving in the chain is given, as this serves as the necessary laxative to remove the meconium. One ounce of linseed oil for 4 or 5 days at night will have the same effect if colostrum is not available, and the calf is fed on whole milk from other cows. I might here remark that hardly any of our calves get colostrum from their dams. Most of them get it from cows due in the chain who have several days to go, as all cows and heifers at Pusa are milked out before calving. Calves born out of the chain, *i.e.*, born from a cow calving down by herself at a time when no other cow is near time never get colostrum, but are given linseed oil and whole milk. Colostrum is not an essential, and such calves under linseed oil made just as healthy animals (Tables I and II).

TABLE I

Weight of calves reared on milk ration from birth

Dam's name	Sex	Sire	Date of birth	Weight in lb.									
				Weight at birth	Weeks								
					1	2	3	4	5	6	7	8
Chansuri .	Cow calf .	Jeswant	18th March 1936	50	54	58	66	68	71	82	90	98
Chakdari .	Bull calf .	Emden .	15th May 1936	52	53	56	60	63	73	81	89	97
Rajurki .	Cow calf .	Narayen	30th May 1936	48	50	52	60	63	67	79	86	88
Lakhati .	Cow calf	Emden .	1st June 1936	45	45	49	56	61	66	74	83	85
Cholmi .	Bull calf .	Maharaj	23rd July 1936	46	47	52	54	58	64			
Lakhwanti .	Bull calf .	Onkar .	7th Aug. 1936	39	40	44	48					
Naruli .	Cow calf .	Onkar .	9th Aug. 1936	48	48	53	57					
Bibsoorti .	Bull calf .	Onkar .	11th Aug. 1936	50	53	56						
			Average .	47·3	48·8	52·5	57·3	62·6	68·2	79·0	87·0	92·0

TABLE II

Weight of calves fed on colostrum from birth

Dam's name	Sex	Sire	Date of birth	Weight in lb.								
				Weight at birth	Weeks							
					1	2	3	4	5	6	7	8
Machrama .	Bull calf .	Jeswant	20th April 1936	41	41	48	48	54	61	70	76	80
Chaprama .	Bull calf .	Emden .	29th April 1936	47	50	56	65	67	71	77	87	92
Naraee .	Cow calf .	Onkar .	3rd May 1936	47	47	49	53	64	66	69	76	84
Chamotli .	Bull calf .	Jeswant	27th June 1936	50	63	68	68	75	81	88	100	109
Mahasam .	Cow calf .	Emden .	10th July 1936	44	47	50	54	60	66	71	77	
Chatuly .	Bull calf .	Emden .	18th July 1936	47	48	50	54	57	61	66		
Lakhmati .	Bull calf .	Emden .	3rd Aug. 1936	49	54	59	63					
Bubla .	Bull calf .	Emden .	6th Aug. 1936	54	56	59	63					
			Average .	47·4	50·8	54·9	58·5	62·9	67·7	73·5	83·2	91·3

All calves are weighed at birth, and their feeding is regulated according to their weight as per chart given below :

Weight of calf at birth lb.	Quantity of milk fed lb.
Under 40	5 to 5½
40—45	6 to 6½
45—50	6½ to 7
50—55	7 to 7½
Over 55	8

N.B.—The general milk of the herd should be fed and *not* the strippings.

All milk is fed at blood heat. There is no variation to this most important rule, which is the controlling factor in most cases of scouring, etc., in calves. Every week the quantity of milk is increased by half pound according to the condition and digestive capacity of each individual calf. They are fed in the beginning thrice daily : 7-30 A.M., 2-30 P.M., 8-30 P.M. for about a month. This period is prolonged to six weeks in the case of weak calves. After a month, only two feeds per day are necessary. That is to say, the same quantity of milk *plus* the weekly increase is given in two feeds instead of three.

After six weeks some fodder, both dry and green, is given to them. Four maunds green fodder and ten to fifteen maunds dry is sufficient for 40 calves of all ages up to 10 months.

Now it is necessary here to digress for a moment and deal with the actual method of calf-feeding. Various dirty labour-saving devices exist for feeding calves in bulk ; wherever I see them, I know the calf mortality is high, because no decent calf-rearer will use them. They take the form of a long fence with moveable bars in which all calves are pinioned to drink. This method does away with all possibility of individual calf-feeding and prevents the early detection of symptoms in a sick calf, until it is probably too late, and also effectually prevents that personal examination of each calf which is so essential to proper calf-rearing. In short, such things in India are merely an excuse for additional idleness and are usually found in farms where supervision is bad, or calves do not matter.

At Pusa, all calves are tied to rings in the floor of a paved yard (in wet weather to similar rings in the floor of the calf boxes). This arrangement is very satisfactory as there is no possibility of feeding a calf twice by mistake, and the space between the rings (7½ feet) prevents them from licking each other. All calves are fed separately. They are able to be examined, brushed and looked over while tied to their rings, and this is the beginning of their handling, and the steadiness of the whole herd starts from this point. A calf and especially a heifer calf gets used to all sorts of people handling it, and it has thus every chance to become absolutely steady with all comers.

We have here both special and ordinary-fed calves. The former are on a ten months' course and the latter six months. Special feeding is given to calves under early maturity experiments. A chart of both scales of feeding is given below :

Scale of calf feeding (ordinary)

Age in week	Whole milk	Skim-milk	Grain	Salt
	lb.	lb.	lb.	oz.
1	8			
2	8			
3	10			
4	10			
5	12		½	1
6	12		½	1
7	12		½	1
8	12		½	1
9	8	2	1	1
10	8	2	1	1
11	6	4	1	1
12	6	4	1	1
13	4	4	1½	1
14	4	4	1½	1
15	4	4	1½	1
16	4	4	1½	1
17	2	6	2	1
18	2	6	2	1
19	2	4	3	1
20	2	4	3	1
21	..	4	3	1
22	..	4	3	1
23	..	4	3	1
24	..	4	3	1

Scale for calf feeding (special)

Age in week	Whole milk	Skim-milk	Grain	Salt
	lb.	lb.	lb.	oz.
1, 2	8			
3, 4	10			

Scale for calf feeding (special)—contd.

Age in week	Whole milk	Skim-milk	Grain	Salt
	lb.	lb.	lb	oz.
5, 6, 7, 8	12		1	1
9, 10, 11, 12	14		1	1
13, 14, 15, 16, 17, 18, 19, 20	10	2	1½	1
21, 22, 23, 24, 25, 26, 27, 28	8	4	2	1
29, 30, 31, 32, 33, 34, 35, 36	6	6	3	1
37, 38, 39, 40	4	6	4	1
41, 42, 43, 44	2	6	4	1
45, 46, 47, 48	..	4	4	1

Do not be afraid if a calf cannot assimilate all its milk ration. Give it the balance in its favour when it can. We give milk due to the calf at 3 weeks sometimes 5 months later, and the result is remarkable.

Additional food.—A quarter ounce of mineral feeding flour and an ounce of linseed meal per head are given to the calves along with grain ration, as per chart given above. Small calves, not getting grain, are given linseed gruel.

Calves here are kept in two groups: one up to ten weeks old and the other over ten weeks up to ten months—each lot being kept quite separate in different boxes and yards. Feeding and grazing arrangements are also quite separate.

For successful calf-rearing individual attention is essential, as the temperament, body-weight, digestive capacity, etc., vary with each animal. The man in charge should exercise his discretion and regulate the food accordingly. This may seem a good deal of trouble to take, but if you are rearing valuable pedigree calves, it is well worth it.

The dangerous time for all calves is from a fortnight up to three months, after that if they are fit and well grown, they will stand almost anything.

III.—Dishorning

All heifer calves are dishorned six days after birth. This is a very simple operation done by the head calf-boy with a stick of caustic potash. If properly done, the operation will not affect the calf at all. The hair is clipped round the base of the coming horns until the base of the button process of the horn can be felt. After moistening, this is then rubbed with caustic potash until redness is noticed. The part requires to be protected with vaseline to prevent the caustic potash travelling down and reaching the eyes. On the fourth day, a scab forms which later falls off of its own accord and requires no treatment. Cows who have been dishorned at birth suffer no inconvenience in any way and are much easier to handle in a dairy herd. They can do no damage to each other when close together, and the percentage of udder injuries in a dishorned herd is noticeably smaller than when horned cows form the majority.

IV.—Body-weight

Do not worry about a calf's birth weight. If it is a healthy calf, a bit under average birth weight, it will make a better animal than a big heavy birth calf with a bad digestion. It is all nonsense to talk about birth weights as representing the signs of deterioration in the breed. Weights vary from individual cows and bulls, and often you will find a heifer dropping a heavier calf than a cow.

Weigh calves every week and watch the weights. Get out your herd standard weight curves and watch each calf's movement against them. Calves

increase by about 7·9 lb. each week [Sayer, 1934]. Thus a normal calf (special-fed) goes from 39 to 48 lbs. in the 2nd week, 126 to 135 lbs. in the 12th, 233 to 242 lbs. in the 24th and 426 to 436 lbs. in the 45th.

V.—Rules relating to successful calf-rearing

The following rules are those current in the calf-yard and are put in here for information. They show the lines on which all the staff are trained in this important subject :—

(*i*) All feeding vessels, water buckets, etc., are to be cleaned and sterilized before use.

(*ii*) Fresh milk warmed up to body temperature must be given. Cold milk is injurious. The mouth of each calf, after they have been fed is wiped thoroughly with a clean wet duster. Immediately after feeding, a little salt is rubbed into the mouth to prevent them from licking each other.

(*iii*) Milk is given in iron pan placed on tripod stand which is convenient both for the calves and the man who feeds them. For three months, they are fed through the finger to prevent them from bolting the milk, after which they are taught to suck the milk from the pan by themselves.

(*iv*) Rock salt in big lumps is kept in the yard, and the calves lick it at will. This also keeps them off from licking walls or eating earth.

(*v*) During the cold months, weak calves and calves up to three months' age are rugged during night.

(*vi*) They are brushed well twice a day ; this does away with ticks, lice, and skin troubles and keeps their coat in good order. They are taken out in the field and made to run about for exercise.

(*vii*) The calf-boxes and yard are cleaned and flushed daily and disinfected. They have cemented flooring. Two long feeding-troughs are provided both in the yard and calf-boxes. There is a watering trough also in the yard.

(*viii*) A dry, light-sheltered place is most suitable for calves, who will never do well in dark, dirty, ill-ventilated places.

(*ix*) Muzzle all calves upto 2½ months when not being fed. Eating dirt and licking walls always bring digestive troubles.

VI.—Diseases and their remedies

Hygienic condition of the surroundings and judicious dieting prevent most of the ailments which calves suffer from.

Scouring.—It is due to exposure to chill, cold milk and letting the calf bolt its food. This is very common and occurs between second and eighth week after

birth. A dose of linseed oil is to be given first to get rid of the curds formed in the stomach. Milk ration is cut down to two-third of the usual quantity (the milk as stated earlier to be fed at body temperature)—skim-milk forming the major portion, and a pound of barley water is added. In more severe cases it may even be necessary to cut down the milk ration to one-third. As this disease has a further tendency to develop into dysentery, castor-oil emulsion should be given thrice daily.

Dysentery.—Castor-oil emulsion thrice daily; dietetic treatment—same as in the case of scouring. The patient is to be segregated, the dung removed and the place disinfected immediately.

Mange.—This is sometimes due to the brushes, muzzles and dusters being unclean. It is, therefore, advisable to clean them every day with hot water and dry them in the sun. The calf is to be segregated.

Clip the hair, wash the parts with soap and warm water and apply tobacco decoction or a mange-dressing consisting of cod-liver oil and mustard oil or any other bland oil in the proportion of 1 : 8.

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EFFECT OF FEEDING VEGETABLE OILS ON THE FAT-CONTENT OF MILK AND ON THE QUALITY OF BUTTER

BY

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NUMEROUS experiments have been carried out by various investigators on the effect of feeding additional fat to cows on the quality and quantity of butter-fat produced, but the results obtained so far have been conflicting. Kellner [1908] had long ago observed that the addition of fat in the ration of cows produced fluctuating changes in the fat-content of milk. Recent investigations made by Allen [1932, 1934] show that feeding of maize, cotton-seed, linseed, earthnut and coconut oils increases the fat-content of milk and that a similar effect is also obtained by the ingestion of milk and cream. Sheehy [1933], on the other hand, has found that vegetable oils have no influence on the fat-content. Sutton, Brown and Johnston [1932] have observed that corn oil has no effect on the yield of milk and butter although it changes the chemical composition of the butter-fat. Hilditch and Thompson [1936] have found that linseed and rape oil increase the proportion of oleic acid in the milk-fat to a marked extent whereas Golding [cited by Hilditch and Thompson, 1936] reported that the ingestion of rape or linseed oil had no effect on the fat-content of milk. M'Candish and Struthers [1935] have found that feeding of butter-fat in the form of butter or cream does not influence either the yield or the composition of milk. The observations of Drummond and Golding [cited by Hilditch and Thompson, 1936] that cod-liver oil in the diet of lactating cows leads to a reduction of the fat-content of milk have been confirmed by several other workers.

It will be seen from the short review of the literature given above that no definite conclusion as to the beneficial effect of vegetable oil feeding on the yield of butter-fat can be drawn. It was, therefore, decided to carry out an experiment on the effect of vegetable oil feeding to dairy cows under ordinary farm conditions and in this paper the results so far obtained are given.

EXPERIMENTAL

Twelve cross-bred cows (Ayrshire-Scindhi) of approximately the same age, lactation period and milk yield (15 to 20 lbs.) were selected and then divided into three groups of four each. One group of cows served as control while the other two groups were fed with groundnut oil and sesame oil, respectively, in addition to the ordinary dairy ration. The basal ration consisted of straw, guinea grass

and *jowar* silage as roughages and a concentrate mixture composed of 4 parts of wheat bran, 2 parts brewery grains, 1 part of gram *chunni*, 1 part of cotton seed, 2 parts of groundnut-cake and salt. After the start of the experiment the above two groups of animals were fed at the rate of 1 lb. of oil per head per day for the first two weeks. The quantity of oil was then increased to two lbs. a day for another two weeks. This was followed by a period of rest lasting two weeks during which the feeding of oil was stopped. The oil feeding was re-started with ½ lb. of oil per head per day for one week and this quantity was again increased to one lb. a day for another week followed by a second period of rest lasting for one week. The oil was fed twice a day mixed up with the concentrate ration. During the whole period of experimentation, the fat-content in the milk of individual cows was determined by Gerber's method daily in the morning and evening. The live-weight of the animals and the roughage consumption were also recorded daily. Butter was made once a week from composite samples of milk and its chemical and physical properties were studied.

Discussion

1. *Effect of oil on the general condition of the animals*

During the entire period the animals relished the concentrate mixture in which the vegetable oil was mixed and no adverse effect on the general health of the animals was observed due to oil feeding. The fæces of the animals in the oil-fed groups were slightly soft as compared to those in the control group. There was no significant increase or decrease in the weight of the animals in any group during the period under observation.

2. *Effect on dry matter consumption*

During the course of the experiment no increase or decrease in dry matter consumption was noticed until the beginning of the fourth week. During the latter period, that is, the second week of feeding oil at the rate of two lbs., a slight decrease in the consumption of dry matter was observed in the second and third groups. This decrease continued until the end of the first week of 'no oil feeding' (rest period) which was the fifth week of the experiment. From the second week of the 'no oil feeding', however, the dry matter consumption again increased to about the same average as it was at the beginning of the experiment.

3. *Effect on milk yield*

Although there was a diminution in the yield of milk owing to advance in lactation in all the groups, no significant effect of oil feeding on the milk yield of the experimental animals could be observed.

4. *Effect on milk-fat content*

No significant variation in the butter-fat content was observed. The data are presented in Tables I and II.

TABLE I

Weekly average percentage of butter-fat

Number of animals		First week	Second week	Third week	Fourth week	Fifth week	Sixth week	Seventh week	Eighth week
		One pound of oil fed	One pound of oil fed	Two pounds of oil fed	Two pounds of oil fed	No oil	No oil	Half a pound of oil fed	One pound of oil fed
Control	1	4·36	4·26	4·45	4·32	4·57	4·45	4·66	4·60
	2	3·35	3·84	3·85	4·05	4·19	4·05	4·17	4·27
	3	4·25	4·37	4·40	4·70	4·77	4·65	4·74	4·06
	4	4·32	4·12	4·10	4·20	4·17	4·40	4·46	4·51
Ground-nut oil	5	5·14	5·13	5·10	4·90	4·66	4·90	5·40	5·52
	6	4·65	4·69	4·45	4·45	4·29	4·60	5·06	5·65
	7	4·43	4·44	4·60	4·45	4·33	4·20	4·52	4·28
	8	4·06	4·10	4·10	4·40	4·39	4·05	4·24	4·45
Sesame oil	9	4·15	4·67	4·20	4·15	4·09	4·20	4·71	4·85
	10	5·12	5·41	4·95	4·90	4·80	4·75	5·27	5·20
	11	4·74	4·85	4·70	4·95	4·76	4·75	4·71	5·02
	12	4·31	4·38	4·15	4·70	4·16	4·85	4·87	4·40

TABLE II

Weekly average of fat percentage of each group

Group	First week	Second week	Third week	Fourth week	Fifth week	Sixth week	Seventh week	Eighth week
	One pound of oil fed	One pound of oil fed	Two pounds of oil fed	Two pounds of oil fed	No oil	No oil	Half a pound of oil fed	One pound of oil fed
Control	4·07	4·14	4·20	4·36	4·42	4·38	4·51	4·61
Ground nut oil.	4·57	4·59	4·56	4·55	4·42	4·43	4·80	4·97
Sesame oil	4·58	4·82	4·50	4·67	4·45	4·64	4·94	4·86

5. *Effect on the quality of butter produced*

(*a*) *Physical.*—The butter in the case of the three groups was made separately from cream without the addition of colouring matter. The process of butter-making adopted was the same in the three cases and the time taken in its preparation was also the same. A study of the physical properties of the three different butter samples from the stand point of taste and flavour showed that the butter from the control group was good and soft whereas the butter from the groundnut oil-fed group was slightly hard, greasy but of good taste and of a nutty flavour, whilst the sample from the sesame oil group was slightly greasy, sweet and hard. A refractometric study of these three butter-fat samples gave a slightly higher refractometer reading in the case of the oil-fed groups.

(*b*) *Chemical.*—The iodine value of the weekly samples of butter of different groups was determined and it was observed that with the feeding of vegetable oils the amount of unsaturated fatty components was considerably increased which was evident by the increase in the iodine absorption values. No differential analysis of the fatty acids in the butter-fat was, however, made.

(*c*) *Vitamin A content in butter.*—Samples of butter from the three groups were periodically tested for vitamin A content by the tintometric method using the antimony trichloride colour reaction and Lovibond scales. The butter samples from the oil-fed groups showed a slight decrease in carotene but no difference in vitamin A content was observed.

Conclusion

From the results of this experiment it is apparent that no appreciable increase occurs in the percentage of butter-fat in milk by additional oil feeding. It is, however, obvious that the extra fat added to the ration must have been to a certain extent metabolised because by its addition the quality of the butter was changed both physically and chemically. It should be observed that the animals under this experiment were kept on the basal ration usually fed at the Imperial Dairy Institute which is well balanced both for maintenance and production and with this type of feed there is no advantage to be gained by feeding any additional vegetable fat.

Summary

A supplement of groundnut and sesame oils to the ordinary dairy ration of cows had no effect on the percentage of fat in milk, although the butter showed marked difference in its chemical and physical properties.

Acknowledgments

We are greatly indebted to Dr. K. C. Sen for his help and guidance and to Mr. Z. R. Kothavala for affording us all facilities. We have also to thank Mr. B. N. Banerjee of the Indian Institute of Science for estimating the vitamin A and carotene content of the butter samples.

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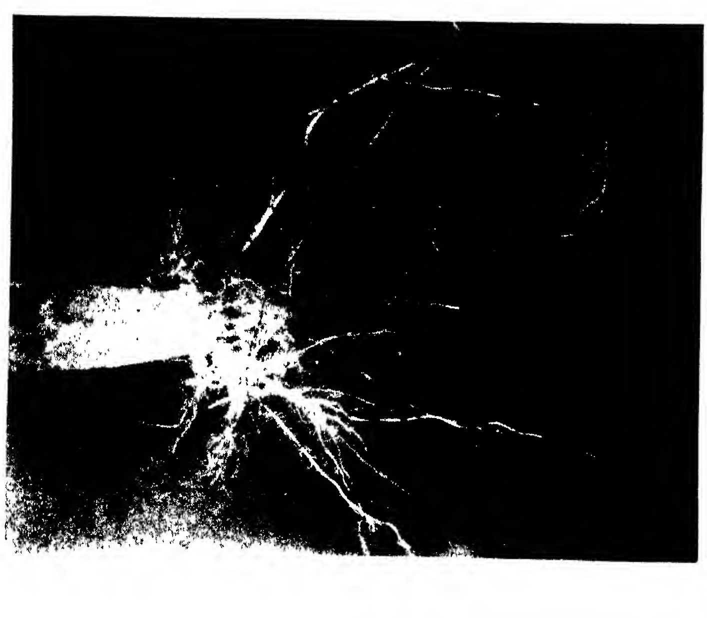

IG. 1. The root-system of a healthy rice plant. Note the mass of secondary fine roots arising from the water roots

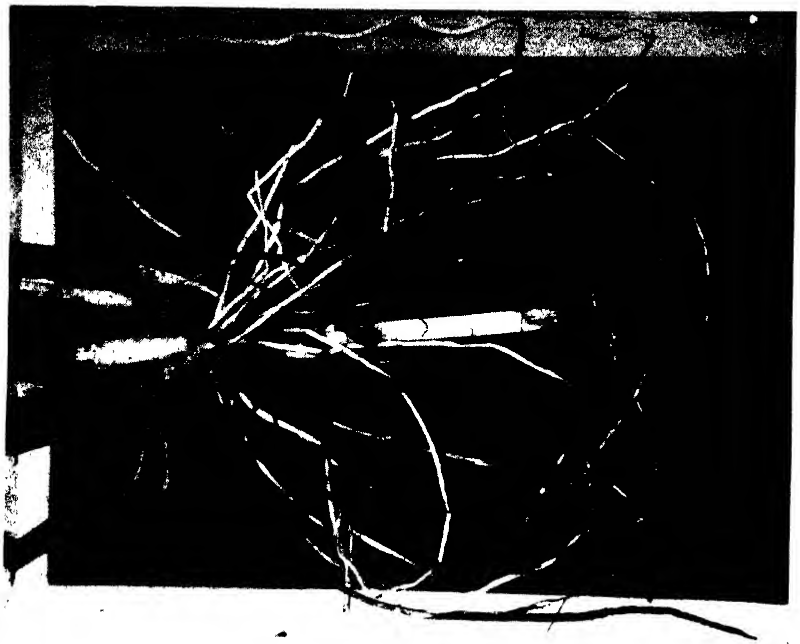

FIG. 2. The root-system of a 'pan-sukh' affected plant. Note the absence of the secondary fine roots and the presence of unbranched dead or dying water roots and the presence of new white water roots developing from the upper nodes

'PAN-SUKH' DISEASE OF RICE IN THE CENTRAL PROVINCES

BY

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A FEW years back in Chhatisgarh Division of the Central Provinces some varieties of rice showed a diseased condition, locally known as 'pan-sukh'. The most conspicuous symptom of the disease was the drying of the outer leaves, hence its local descriptive name. This diseased condition was found only in certain fields, and the varieties of rice chiefly affected were Gurmatia and Bhata Gurmatia ; Luchai also was susceptible but not as much as the other two.

Last year (1936) there was an outbreak of a similar disease in some villages in Nagpur Division. Here also the variety of rice affected was Gurmatia.

Plants may show signs of disease even before they are two months old. The first symptom of the disease is the drying of the outer leaves. In a diseased field only a few green leaves can be seen amongst a mass of brown dry leaves. If this diseased condition is present early in the season when the plants are very young there is very little tillering, the plants bear very few leaves, are very much attenuated, and hardly come to head. In the few cases where heads are developed they are always light ; they may not wholly emerge from the enveloping sheath, the lower part remaining enclosed within it. The flowers are sterile but the glumes are normal in shape and colour ; they are not distorted. If, however, the diseased condition occurs later in the season when the plants are full grown the tillering is more or less normal but the outer leaves are prematurely dry and the heads are light, and in some cases they emerge only partially through the sheath.

Affected plants do not show the presence of any pathogenic organism. The leaves are uniformly dry and have no lesions on them. The stems of the parent plants and of their tillers are clean and healthy looking, though they may be thinner than those of normal healthy plants.

The root-system of a plant suffering from 'pan-sukh' disease is different from that of the normal healthy plant. The healthy plant has two kinds of roots, long thick coarse roots or water roots, and a large mass of secondary fine roots which are so much entwined round each other and round soil particles that they form a thick mat enclosing a lot of soil from which the roots cannot be readily released (Plate XXX, fig. 1). These fine roots are developed from the branches of

the coarse roots or water roots, which also bear a large number of root-hairs. The root-system of a diseased plant chiefly consists of long coarse roots or water roots which are very sparsely branched, if branched at all; the lower portion of these roots is dead or dying, and root-hairs are absent. There is no mat of entangled secondary roots and water roots; the water roots can be readily freed from the adhering soil (Plate XXX, fig. 2). From the upper nodes which are submerged in water are developed new adventitious roots and it is these roots that keep alive the plant even when most of its outer leaves are dead or dying, and the early formed root-system is decaying. These new adventitious roots from the upper nodes are developed too late in the life of the plant to do more than just to keep the plant alive; the new root-system is not sufficiently well developed to enable the plant to put forth a vigorous growth; that is why the plant is not usually able to come to head and when it is able to produce a head it is poor and empty.

Field experiments and pot experiments have shown that these symptoms of 'pan-sukh' disease can be reproduced. In the field experiments at Chandkhuri (Raipur District) the disease was reproduced on Bhata Gurmatia, Gurmatia and Luchai when in the field water was never drained off but was always allowed to stand. In the field which was occasionally drained or in which water was not allowed to stand this diseased condition did not occur. Bhondu and some other varieties of rice did not show this diseased condition even when water was kept standing continuously from the time of planting the seedlings till harvest time.

Field experiments at Chandkhuri have further shown that if affected fields are drained as soon as the plants begin to show this diseased condition and allowed to dry before water is again turned on in them, the plants revive and put forth a vigorous and normal growth; at the end of the season these fields cannot be differentiated from other fields where the plants have not been similarly affected Naturally water cannot be drained off from fields if the diseased condition occurs late in the season when the plants are full grown and about to head; at this stage the addition of ammonium sulphate at the rate of 30 to 50 lb. per acre stops further progress of the disease and enables the plants to head normally. In Chhatisgarh Division ammonium sulphate is now largely used for checking this disease; it is applied even when the diseased condition occurs when the plants are young.

Shaw [1922] from an examination of dry herbarium specimens of diseased rice " from the districts of Raipur and Bilaspur in the Central Provinces " came to the conclusion that the diseased condition resembled the straight-head disease of rice reported by Tisdale and Jenkin [1921] to be " one of the most destructive diseases of irrigated rice in the southern part of the United States ". Shaw does not give the description of the diseased condition " which has been observed in India in specimens submitted for mycological examination ". The 'pan-sukh' disease of rice observed in Raipur and Bilaspur and other parts of the Central Provinces shows a resemblance to the straight-head disease mentioned above only if the root-system is compared, but the above-ground parts do not show the least

resemblance. In both cases there is the presence of dead and unbranched coarse roots or water roots, absence of root hairs and very little development of secondary fine roots. In the case of straight-head disease the affected plants "are very hard to detect before they start heading"; the leaves do not dry prematurely but they are darker green in colour than those of healthy plants; leaf sheaths adhere closely to the stem. In 'pan-sukh' affected plants leaf sheaths and leaves do not show these symptoms. In the straight-head affected plants the heads emerge slowly and do not extend as far above the top sheath as in the normal plants and the glumes are distorted or aborted. If the 'pan-sukh' affected plant does come to head it does not open freely but its lower part remains enclosed within the leaf sheath and the head is wholly empty, but the glumes are normal in shape.

Summary

A diseased condition of rice known as 'pan-sukh' disease in Chhatisgarh Division and Nagpur Division of the Central Provinces is described. 'Pan-sukh' is a physiological disease. The leaves dry prematurely and the root-system is abnormal. 'Pan-sukh' disease is not the same as the straight-head disease which is a most destructive disease in the southern parts of the United States.

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DIAGNOSIS OF OLEIFEROUS *BRASSICAE* SEEDS

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Toria (*Brassica napus* L. var. *dichotoma* Prain), brown *sarson* (*Brassica campestris* L. var. *sarson* Prain) and *raya* (*Brassica juncea* H. F. and T.) are the only important Oleiferous *Brassicæ* grown in the Punjab. Many farmers often purchase seed from bazaar and complaints have been sometimes received that the crop raised from such seed is a mixture of two or more of these crops. In some cases the entire crop turns out to be *raya* or *toria* instead of *sarson* and *vice versa*. This is due to the fact that the seeds of certain forms of *toria*, *sarson* and *raya* cannot be easily distinguished from each other. It was, therefore, considered desirable to find a way of doing so. Differences in the colour, size and taste of seeds have in the past been ordinarily regarded as the characters for determining the identity of samples but observations made on a large number of *Brassica* seed samples have definitely shown that no marked difference with regard to these characters is exhibited in seeds of different forms of the above-mentioned three crops. Recently we have found some more reliable tests. The identification is based on two characters, *viz.*,

(*a*) markings on the surface of the seeds, and

(*b*) the mucilaginous contents of their epidermal cells, which vary sufficiently in these seeds to ensure their easy identification.

The methods used are briefly as follows :—

(*a*) The representative samples of seeds are mounted in water and examined under a lens. The *raya* seeds show marked reticulation whereas *toria* and *sarson* seeds show very faint reticulation (Plate XXXI, fig. 1).

(*b*) Representative samples of seeds are mounted in water for about one hour and then examined under the microscope. *Sarson* seeds show a very prominent mucilaginous layer on their outer surface, while *raya*

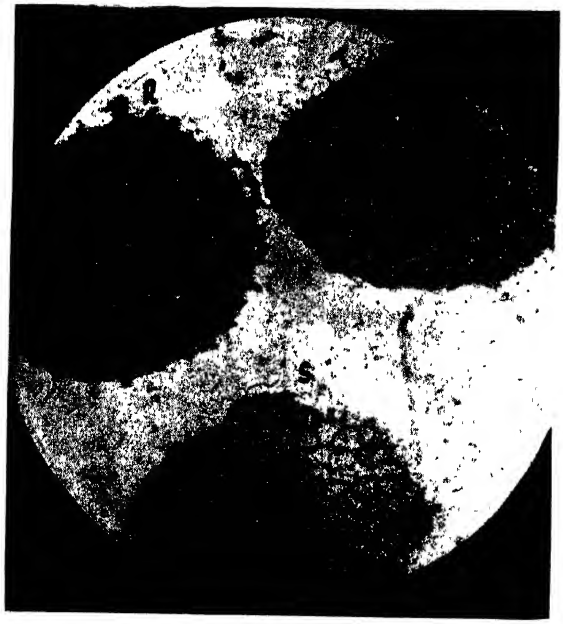

FIG. 1.—*R*—*Raya* ; *T*—*Toria* ; *S*—*Sarson*

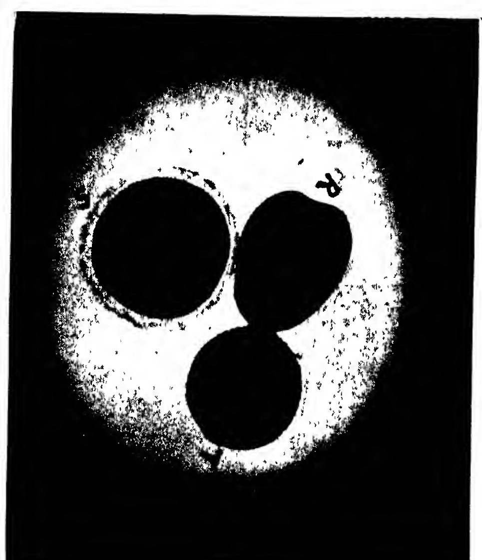

FIG. 2.—*R*—*Raya* ; *T*—*Toria* ; *S*—*Sarson*

and *toria* seeds show practically no mucilage (Plate XXXI, fig. 2). The actual measurements of mucilaginous layer on the surface of brown *sarson* seeds were recorded and on the average of two thousand determinations, the thickness of the mucilaginous layer in *sarson* seeds was found to vary between 0·1 mm. to 0·5 mm. The mucilaginous substance on the surface of these seeds becomes very easily distinguishable by mounting in certain colouring materials. The best results have so far been obtained by using safranin.

NOTES

SCIENTIFIC CO-OPERATION ON A COMMONWEALTH SCALE

THE British Commonwealth Scientific Conference met in London in September 1936. It has already been mentioned in the 'Editorial' of the May issue of this Journal. The Conference, however, was of such importance both scientifically and administratively that we have no hesitation in once more drawing attention to it, and to the desirability of all those interested in such work obtaining a copy of the Report of the Conference. This Report is published by H. M. Stationery Office, Adastral House, Kingsway, London, at the very modest price of one shilling and three pence. In order that readers may get some idea of the work done we are reprinting below from that Report the Summary of Conclusions and Recommendations, and we also give the full text of the speech by the Right Hon'ble Sir Walter Elliot, then Minister of Agriculture and Fisheries, and the list of members.

The Right Hon'ble Sir Walter Elliot's speech, the editorial above mentioned, and the summary of conclusions and recommendations will between them give a fair picture of the doings and plannings of the Conference. As usual on such occasions, tours were arranged for the inspection of Bureaux and Institutes. Such tours are always very fruitful, not only in the amount of knowledge gleaned by delegates and imparted to the workers in Bureaux and Institutes, but also in the development of that better knowledge of each other that results when people travel together and have the opportunity of discussing at length and informally the many things that interest them.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

(*i*) The organization and direction of the bureaux and institutes administered by the Executive Council of the Imperial Agricultural Bureaux accord with the principles laid down in the Report of the Imperial Committee on Economic Consultation and Co-operation and approved by governments. The work and usefulness of these organizations are satisfactory and they afford an example of effective co-operation on a true intra-Imperial basis.

(*ii*) Contact between individual bureaux and institutes on the one hand and Commonwealth research workers on the other would be improved by the appointment by each contributing Government of one or more liaison officers (in addition to the present scientific correspondents) to cover the field embraced by all the bureaux and institutes. It would be the duty of such liaison officers to foster greater co-operation between the bureaux and institutes and the research workers in their own countries.

(*iii*) The Executive Council is asked to examine carefully the question of the distribution of Bureau publications, particularly the possibility of increasing revenue

from this source by raising prices, reducing the free list, and charging higher prices to subscribers from non-contributing countries. Proposals are made regarding the number of copies which each contributing area should receive in return for its contribution to the cost of the Bureaux.

(*iv*) It is recommended that further steps should be taken, both by the Executive Council and the bureaux, to make known the services which the bureaux are able to render. Attention is drawn to the desirability that research workers generally should possess, as part of their normal equipment, the bureau journals covering their respective field.

(*v*) Charges should be made by the bureaux for translations made by them of papers not of general interest.

(*vi*) The practice of holding regular meetings of directors and of deputy directors is commended.

(*vii*) Every encouragement should be given by governments to methods by which adequate personal liaison may be established between the bureaux and Commonwealth research workers.

(*viii*) The List of Agricultural Research Workers in the British Empire, published annually by the Executive Council, should be revised, so that the List is strictly limited to those who are engaged in research, or actively concerned with its organisation; further, a brief indication of the special line of study of each research worker should be given.

(*ix*) The Conference re-affirms the principle that a bureau may be established in any part of the Commonwealth, or transferred from one part to another, and suggests that the application of this principle should be considered by the Executive Council from time to time, and should be raised at the next Conference.

(*x*) *Bureau of Soil Science.*—(*a*) In view of the increasing importance of soil science to forestry closer contact between the bureau and forestry officers merits consideration.

(*b*) In collaboration with other bureaux, including those dealing with Animal Health, Fruit Production and Plant Genetics (Herbage Plants) the Bureau of Soil Science could with advantage issue, at intervals, a special supplement containing extended titles of papers of interest to agricultural meteorologists, particularly papers dealing with the relationship between biological activities and weather influences.

(*xi*) *Bureau of Animal Nutrition.*—Appropriate steps should be taken to extend the circulation of "Nutrition Abstracts" among scientists interested in both human and animal nutrition.

(*xii*) *Bureaux of Plant Genetics (for Crops other than Herbage) and Plant Genetics (Herbage Plants).*—(*a*) Some re-arrangement of the duties of these two bureaux is recommended, the former (Cambridge) to be responsible for abstracting genetical research papers on all crops, and the latter (Aberystwyth) to deal with genetics only in special circumstances, devoting more generally attention to pastures and to forage crops as referred to hereunder. The title of the former bureau should be altered to "The Imperial Bureau of Plant Breeding and Genetics" and of the latter to "The Imperial Bureau of Pastures and Forage Crops".

(*b*) Subject to the foregoing the Aberystwyth bureau should deal with pastures and forage crops together with important papers on plant physiology as applied to these crops. The two bureaux should continue to pay attention jointly to the important subject of vernalization.

(*xiii*) *Bureau of Fruit Production.*—An extension of the abstracting work to cover more fully vegetables and glasshouse crops is desirable, and should be adopted so far as financial arrangements permit. The title should be altered to " The Imperial Bureau of Horticulture and Plantation Crops ".

(*xiv*) *Bureau of Animal Genetics.*—The Executive Council should endeavour to arrange for the appointment of a deputy director at the earliest practicable date. The title of the Bureau should be altered to " The Imperial Bureau of Animal Breeding and Genetics ".

(*xv*) *Bureau of Agricultural Parasitology.*—This bureau deals with Helminthology and for the present it is not considered desirable to include protozoology within its scope. The title should be altered to " The Imperial Bureau of Agricultural Parasitology (Helminthology) ".

(*xvi*) *Finance of the eight existing bureaux.*—The Conference recommends that over the five year period commencing 1st April 1937 the contributing Governments should continue to provide for the eight existing bureaux a sum of £21,800 annually, divided between them in the proportions agreed for the annual sum of £20,000 under the original scheme, framed in pursuance of the recommendations of the 1927 Conference. In order to meet existing commitments and the increasing demand on the bureaux's services a further sum of £6,000 spread over the quinquennium, and shared in the same proportions, should also be contributed. Should it prove impracticable to assemble before the autumn of 1941 a further Conference to examine and review the work of the Council and of the bureaux, then the steps suggested in paragraph (*xxxi*) of this summary should be taken by the Executive Council.

(*xvii*) *Imperial Institute of Entomology.*—The Executive Council should examine further the practicability of the division of the Institute's services into (*i*) bureau and (*ii*) other activities and of introducing a system of payment for identification services rendered by the Institute.

(*xviii*) The Executive Council should examine the possibility of increasing revenue by raising the prices of the Institute's publications, with suitable discounts to subscribers from contributing countries, and of reducing the free list. A revised basis for the distribution of free issues is suggested.

(*xix*) The advantage of extending the Institute's work in directions recommended by the Entomological Conference 1935 is emphasized, and possibilities of securing this end are referred to in detail below, additional contributions of £750 a year being contemplated for this purpose.

(*xx*) *Farnham House Laboratory.*—The Laboratory should be continued on an intra-Imperial basis, a sufficient sum being contributed by governments to provide for the maintenance of headquarters and equipment and the retention of a nucleus staff. Proposals are made for the distribution of this sum between governments.

(*xxi*) It is recommended that charges be made for all work carried out by the Laboratory in response to requests. In the case of special projects, the basis of charge should be :—

(*a*) all travelling and subsistence expenses ;

(*b*) the full salaries of officers for the time they are employed on such projects ;

(*c*) incidental out-of-pocket expenses ; and

(*d*) five per cent on the sum of (*b*) and (*c*) towards overhead expenses.

For other services charges should be determined by the Executive Council. Contributions by governments for headquarters and nucleus staff should be reduced in future years provided the executive Council are satisfied that the surplus that may have accrued, by reason of receipts from the charges made, justifies such reduction.

(*xxii*) *Imperial Mycological Institute.*—In regard to the Institute's publications, proposals are made on similar lines to those suggested for the Imperial Institute of Entomology.

(*xxiii*) The Institute's financial position and urgent additional needs during the next five years would be safeguarded if certain increases in annual contributions by governments materialise, amounting to £600 a year.

(*xxiv*) *New Bureau of Dairy Science.*—The Conference recommends the formation, as a part of the general bureau service under the Executive Council, of an Imperial Bureau of Dairy Science at a cost of 1,800 a year for five years beginning 1st April 1937, that sum to be divided among governments in the proportions accepted for the division of the £20,000 per annum originally provided for the existing bureaux. Subject to the consent of the Governing Body of the National Institute for Research in Dairying, Shinfield, near Reading, it is recommended that the new Bureau be placed at that Institute.

(*xxv*) From the year in which an Imperial Bureau for Dairy Science is established the deficiency grant now made by the Executive Council to the Journal of Dairy Research should cease ; until then the grant might be continued, but if for any reason the establishment of the Bureau of Dairy Science is deferred, the amount of the grant should be progressively reduced with a view to early extinction.

(*xxvi*) *New Bureau of Forestry.*—The Conference submits for the favourable consideration of governments a proposal for the establishment of an Imperial Forestry Bureau on lines similar to the agricultural bureaux, and with its organization and control entrusted to the Executive Council. It is considered that a sum of £3,000 a year for the first five years will be sufficient for this bureau, in the form of contributions from governments in the same proportions as othe cntributions to the existing bureaux. An indication is given of the field of work which it could conveniently cover and the question of the particular Institute within the Commonwealth at which the bureau, if approved, should be located should be examined by the Executive Council.

(*xxvii*) *Research on the Transport and Storage of Foodstuffs.*—The Conference emphasises the necessity for research on both the fundamental and applied aspects of transport and storage problems being undertaken or continued in the Dominions and Colonies as well as in the United Kingdom. The real need for an information service by which research workers may be kept advised of the large and growing scientific

literature related to these problems is recognized, and the Conference records the fact that this matter is under consideration by the Department of Scientific and Industrial Research in the United Kingdom, which already issues an "Index to the Literature on Food Investigation", which partly meets the need.

(*xxviii*) The Conference considers that the contributions of certain overseas countries towards the expenditure of the Food Investigation Board of the United Kingdom should continue to be a matter for arrangement between the individual governments concerned and dealt with as heretofore, and that it is undesirable to formulate general principles concerning them.

(*xxix*) *Control of insect infestation of stored products.*—The Conference appreciates the valuable work carried out at the Stored Products Research Laboratory of the Imperial College of Science and Technology at Slough, and expresses the hope that although the work is no longer supported by financial contributions through the Executive Council, the Director will keep the Executive Council informed of the activities of the Laboratory through publications, and if feasible by communicating from time to time his programme of work.

(*xxx*) *Wool research.*—The Conference considered the future of the contributions, totalling £2,000 per annum, now being made through the Executive Council to the Wool Industries Research Association, and also a memorandum (so far as it related to research) presented by New Zealand outlining extensive proposals for further work in aid of wool interests. It recommends :—

(*a*) that governments concerned should encourage the holding of a special conference to consider the possibilities of organizing a co-operative scheme which would cover research on utilization of wool and the extension of its use ;

(*b*) that governments be invited to consider favourably the possibility of continuing as an interim measure, pending further examination, the payments which they are at present making through the Executive Council for work done by the Wool Industries Research Association.

(*xxxi*) *Periodical examination of Council activities by conferences.*—The Imperial Committee on Economic Consultation and Co-operation recommended that the activities of intra-Imperial agencies should be reviewed periodically by conferences suitable for the purpose, which should also consider what financial provision would be adequate for a period of succeeding years. The Conference recommends that the Governments of the British Commonwealth be requested to arrange for the assembly of a conference similar to the present one between July and September 1941, and that that conference should be charged—

(*a*) to review and examine all activities associated with the Executive Council ;

(*b*) to consider and make recommendations concerning the financial provision required for the ensuing five year period for whatever activities may be entrusted to the Council ;

(*c*) to consider such resolutions passed at specialist conferences held in the meantime as may have been referred to the Council ; and

(*d*) to consider such subjects as may have been previously agreed upon by governments.

Further, the Conference recommends that should it prove impracticable to assemble within the period suggested a conference for the consideration of the financial questions referred to in (*b*) above, the Executive Council should bring the matter to the notice of governments in due time, in the expectation that the contributions to the various activities of the Council will be continued at the existing rates, pending consideration by such conference.

(*xxxii*) *Feasibility and advisability of* (*a*) *Periodical Specialist Conferences,* (*b*) *of a General Commonwealth Conference on Agriculture, and* (*c*) *of a General Scientific Conference.*—The Conference considers that, for various administrative reasons, it is not practicable at present to convene either a general Commonwealth Scientific Conference or one covering the whole field of the science of agriculture.

It recognizes the value of specialist conferences—that is conferences each dealing with a special science or with a special subject which may concern one or more scientific departments—but considers that the agenda for such conferences should be restricted to scientific subjects and to technical administrative matters related thereto.

In arranging specialist conferences, the dates of meetings of cognate international conferences could with advantage be kept in view, and also the possibility of co-ordinating the dates of separate specialist conferences where closely allied sciences are concerned.

(*xxxiii*) *Proposal for an organization to ensure fuller co-operation in scientific research.*—In the discussion on this proposal a distinction was drawn between the furtherance of voluntary collaboration in scientific research and the particular method suggested in this proposal as one possible means of securing it. The organization proposed presented constitutional and practical difficulties. The Conference, moreover, noted that it is within the competence of the Executive Council within the limits of its constitution, to submit to governments from time to time proposals for co-operative action in regard to scientific research. In these circumstances the Conference decided to take note of this paper.

(*xxxiv*) *Co-operation in obtaining and maintaining plant material for crop improvement.*—It would be an advantage if, when a country is planning an exploratory expedition to obtain new plants or species, it would send full particulars to the Executive Council, so that other countries within the British Commonwealth could be informed and given an opportunity of sharing therein, if they wished. The Conference considers that the work of plant improvement would be assisted, and the exchange of material facilitated, were Plant Breeding Stations to maintain detailed descriptive lists of the material they have, and to send such lists to the appropriate bureau for the information of other countries. The Conference accordingly remits these two questions to the Executive Council for further consideration.

(*xxxv*) *Interchange of research workers, of information and of programmes.*—The exchange of officers, one for one, between institutions in different countries of the Commonwealth is rarely practicable. The Conference attaches, however, great importance to visits of research workers to institutes in other countries, and to fuller exchange of programmes of work. As a particular instance it welcomes the offer by the Department of Scientific and Industrial Research (United Kingdom) to receive at its Building Research Station and at the Road Research Laboratory officers from overseas

governments to enable them to obtain experience of the technique and methods developed at these Stations for the study of building and road problems.

(*xxxvi*) *Investigation into control of damage by termites.*—In view of the economic importance of this problem, and of the work that is being done upon it in many parts of the British Commonwealth, the Conference commends to governments the desirability of arranging for fuller interchange of information on all aspects of this problem, and recommends that the Executive Council should be requested to arrange for the dissemination of that information classified according to the several aspects of the problem.

(*xxxvii*) *Uniformity of health certificates accompanying exports of living plants.*—The Conference notes the valuable progress which has been made in securing agreement within the Commonwealth to the model form of health certificate to accompany exports of living plants, and recommends that those governments which have not yet intimated their views, or which have so far been unable to accept the model form completely, might be invited to consider or reconsider the possibility of doing so.

(*xxxviii*) *Research work towards the standardization of methods for testing the efficacy of fungicides and insecticides.*—The Conference draws attention to the need in the various parts of the Commonwealth for fundamental research into methods for the biological standardization of fungicides and insecticides, and considers that it would be of material assistance to those already engaged on that work if the Executive Council could collect programmes of work, preliminary results and reports, and circulate them for the information of research organizations.

Speech by the Right Hon'ble Walter Elliot, M.P., M.C., F.R.S., at the British Commonwealth Scientific Conference, 1936

Gentlemen, my pleasant task is to welcome you on behalf of His Majesty's Government in the United Kingdom and to declare the Conference open. As you know, the Conference owes its origin to the successful Imperial Agricultural Research Conference of 1927, which was presided over by Lord Bledisloe. I am sure the whole Conference will recollect with pleasure that since that time Lord Bledisloe has added to his laurels and, as Governor-General of New Zealand, he took, as he still does, a great interest in the scientific side of agriculture. From that meeting the chief practical result was the foundation of the eight Imperial Bureaux to serve as centres of information in the eight branches of agricultural research. As we all well know, an entirely new form of organization was evolved for the control and administration of these Bureaux, under which complete responsibility was given to a Council representative of the various Empire Governments and constituted on a basis of complete equality. Funds are provided by all the governments on a proportional basis and the staff engaged by the Council for the work of the bureaux are, not only in theory but in fact, the servants of all the governments and not of any one particular Government of the British Commonwealth of Nations. I think it is remarkable that a machine so devised has worked without any formal charter, without any legal difficulties and without any friction. I well remember the discussions which took place at the Conference in regard to the possibility of establishing such a body. I think it owes its fortunate course since that time to the fact that our thoughts were concentrated upon what we desired to do and

not upon the formulæ under which the work would be done. I think it is a notable achievement of collaboration between the various governments in the Commonwealth and I think the Council has fully carried out the intentions of the Imperial Agricultural Research Conference of 1927.

The scientific activities of the Empire, amongst others, were reviewed at the Ottawa Conference and, after that. by the Skelton Committee, and it is under a recommendation from the Skelton Committee that we are meeting this morning. The Committee recommended that the question of what research activities could in future be carried out co-operatively should be considered by a Conference to be summoned as early as possible consisting partly of the administrative and scientific heads of all National Research Organizations and Departments and partly of such other persons as the several governments should select, and it is in pursuance of the above recommendation, accepted by all the governments, that the United Kingdom Government, with the concurrence of the other Commonwealth Governments, has convened the present Conference.

Your agenda is here. It is of course strictly limited in scope. The business is twofold. It is first to consider the future work, the finance, and the possible expansion of usefulness of the eight Agricultural Bureaux and the Imperial Institutes of Entomology and Mycology ; I see also that proposals have been presented for the establishment of new bureaux in dairying and forestry, respectively. Secondly, the Conference has to consider certain research activities which now receive financial assistance from some governments through the Executive Council, namely, the transport and storage of foodstuffs, wool, the control of the insect infestation of stored products. Apart from these main functions I understand that the opportunity is being taken to permit the Conference to discuss general questions of how scientific collaboration throughout the Empire can be furthered by, for example, improving the existing arrangements for periodical Conferences and, either in general fields or in special fields, by improving the arrangements for the exchange of information and of programmes and the interchange of workers. I need hardly say, at a gathering which has had such a large first hand acquaintance with scientific work, how much importance one must attach to the actual interchange of workers and to the familiarizing of the workers in one continent with the conditions under which their colleagues are working in other continents. Lastly I see that your agenda provides for discussion in a broad way, subject of course to the general agreement of the participating delegations, of a few special subjects which I need not specify.

Well, gentlemen, it is my function to welcome you on behalf of the United Kingdom Government. We attach great importance to our research activities. They are spread over many fields. We in the United Kingdom recognize that many of the problems facing a modern government cannot possibly be solved without calling in the aid of the scientist and I think we can say, all of us, that in this co-operative endeavour none of us is lying back and letting the other fellow do the work. I think we can truthfully say in the United Kingdom that we are taking our full share in this joint enterprise. We have worked on many of the problems which you will have to consider. The low temperature work of the Food Investigation Board both at Cambridge and at the Ditton Laboratory has been of great benefit both to home and overseas

producers. The gas storage of fruit I think was first undertaken in the interests of home growers, and it is a striking example that the first commercial application of that knowledge was made in the transport of overseas products, apples from Australia, so that a system of food protection which was designed to permit the transport of goods through a space of time was first applied in the transport of goods through physical space.

Gentlemen, you have much ground to cover in the field of scientific investigation and it is not my business this morning to encroach upon your preserves. I feel there is no doubt at all that the fullest collaboration between scientists is necessary to-day. The successful work of the Imperial Agricultural Bureaux is I think almost unique in its basis of co-operation and I hope very much that such an effort may expand and become more fruitful as the years go on. This is an association of people who say 'Yes' to the forces of abundance and it is your task to give to us, to the administrators, the politicians, the heads of governments, the head of steam to work on. It is our task to regulate that head of steam and to use it well. It may be that we are not always so successful in using that head of steam as you are in producing it, and it is certainly true that the regulation of that head of steam involves blowing a little of it off now and again, and during that process we are apt to be subject to somewhat acute criticism. Apart from that, you are engaged here in the development of a community of thought and culture, and that is fundamentally the link by which the British Commonwealth of Nations is kept together. That is the true commonwealth, the head of knowledge which is not consumed by use, but the more it is drawn upon the greater it grows.

Here we are met together to carry through another stage in the process which was begun by a Government under the auspices of Lord Balfour, one of the most striking examples of the man interested in science, understanding science, utilising science, and yet also through half a century engaged in problems of administration. We are glad to see you here. We are glad to realize that you are going to see something of our country and our activities and we hope you will have a happy and useful time in your visit to the United Kingdom.

List of Delegates

United Kingdom

Sir Charles J. Howell Thomas, K.C.B., K.C.M.G., Ministry of Agriculture and Fisheries (*Chairman of the Conference*).

Sir Frank E. Smith, K.C.B., C.B.E., D.Sc., LL.D., F.R.S., Secretary, Department of Scientific and Industrial Research.

Mr. C. Nathan, Ministry of Agriculture and Fisheries.

Dr. E. J. Butler, C.M.G., C.I.E., D.Sc., M.B., F.R.S., Secretary, Agricultural Research Council.

Dr. E. Mellanby, M.D., F.R.C.P., F.R.S., Secretary, Medical Research Council.

Mr. P. R. Laird, C.B., Secretary, Department of Agriculture for Scotland.

Dr. G. Scott Robertson, D.Sc., Secretary, Ministry of Agriculture, Northern Ireland.

Mr. G. Kimber (Observer), Dominions Office.

Canada

Major-General A. G. L. McNaughton, C.B., C.M.G., D.S.O., LL.D., M.Sc., President, National Research Council of Canada.

Dr. G. S. H. Barton, C.M.G., B.S.A., D.Sc.A., Deputy Minister, Dominion Department of Agriculture.

Dr. J. M. Swaine, B.S.A., M.Sc., Ph.D., F.R.S.C., Director of Research, Dominion Department of Agriculture.

Dr. Robert Newton, M.Sc., D.Sc., Ph.D., F.R.S.C., Director of Agricultural Research, National Research Council of Canada.

Mr. L. B. Pearson, O.B.E., First Secretary, Office of the High Commissioner for Canada.

Monsieur Pierre Dupuy, M.A., LL.D., Lic en Droit, Lic. ès Letters (Paris), Canadian Legation, Paris.

Mr. S. J. Cook, M.A., A.I.C., F.C.I.C. (Secretary to the Delegation).

Commonwealth of Australia

Sir David Rivett, K.C.M.G., D.Sc., Deputy Chairman and Chief Executive Officer, Council for Scientific and Industrial Research.

Sir Charles J. Martin, C.M.G., M.B., D.Sc., D.C.L., LL.D., F.R.S., Council for Scientific and Industrial Research.

New Zealand

Professor H. G. Denham, D.Sc., F.R.S.N.Z., Chairman, Council of Scientific and Industrial Research.

Professor W. Riddet, B.Sc., Member of Council of Scientific and Industrial Research.

Mr. Nevill L. Wright, F.I.C., D.I.C., Liaison Officer in London of the Council of Scientific and Industrial Research.

Union of South Africa

Dr. P. R. Viljoen, Dr. Med. Vet., M.R.C.V.S., Secretary for Agriculture and Forestry.

Mr. J. D. Keet, Director of Forestry.

Dr. G. v. d. W. de Kock, D.Sc., Dr. Med. Vet., M.R.C.V.S., Deputy Director of Veterinary Services.

Mr. F. J. du Toit, Trade Commissioner in London.

Irish Free State

Mr. D. Twomey, Secretary, Department of Agriculture.

Mr. J. M. Adams, Chief Technical Adviser, Department of Agriculture.

Mr. C. J. O'Donovan, Secretary, High Commissioner's Office.

Newfoundland

Mr. D. J. Davies, C.B.E., Trade Commissioner in London.

India

Sir Bryce C. Burt, C.I.E., M.B.E., Acting Vice Chairman, Imperial Council of Agricultural Research.

Mr. (now Sir) C. G. Trevor, C.I.E., Inspector-General of Forests.

Lieutenant-Colonel G. G. Jolly, C.I.E., M.B., Ch.B., I.M.S., Acting Public Health Commissioner with the Government of India.

Southern Rhodesia

Dr. D. W. Blackie, M.D., D.Sc., D.T.M. & H., Director of Pasteur Institute.

Mr. A. D. Husband, F.I.C., Chief Chemist, Department of Agriculture.

Mr. B. F. Wright, Official Secretary, Office of the High Commissioner for Southern Rhodesia, London.

Colonial Delegation

Mr. R. V. Vernon, C.B., Assistant Secretary, Colonial Office.

Mr. F. A. Stockdale, C.M.G., C.B.E., Agricultural Adviser, Colonial Office.

Dr. H. A. Tempany, C.B.E., Assistant Agricultural Adviser, Colonial Office.

Sir Geoffrey Evans, C.I.E., Principal, Imperial College of Tropical Agriculture, Trinidad.

Mr. W. Nowell, C.M.G., C.B.E., Director, East African Agricultural Research Station, Amani.

Mr. O. T. Faulkner, C.M.G., Director of Agriculture, Straits Settlements.

Major H. H. Brassey-Edwards, O.B.E., M.R.C.V.S., Deputy Director of Animal Industry and Chief Veterinary Officer, Kenya.

Mr. J. P. A. Morris, M.R.C.V.S., Director of Animal Health, Northern Rhodesia.

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SCIENTIFIC RESEARCH IN INDUSTRY

THE following are extracts from a summary of the Report of the Department of Scientific and Industrial Research for the year 1935-36* (Cmd. 5350).

CHANGE IN OUTLOOK OF BRITISH INDUSTRY TOWARDS RESEARCH

The Advisory Council of the Department of Scientific and Industrial Research, of which Lord Rutherford is the Chairman, directs attention in the Department's Annual Report just issued (H. M. Stationery Office, 3/-nett) to important developments in the outlook of industry in this country. The last five years have witnessed, the report states,

> " the fruition of the policy adopted by several large industrial undertakings of setting well-balanced teams of research workers, including chemists, physicists, engineers and where necessary biologists, to solve

*Copies are obtainable from H. M. Stationery Office, Kingsway, London, W. C. 2 or through any book seller. Price 3/-nett.

> a particular problem or to develop a new product. This method of attack has led to the steady improvement of the efficiency of electric lamps to the position this country has won in high-definition television, to the development on a commercial scale of the huge plant for the conversion of coal into oil by hydrogenation, to the growth of the plastics industry and to many other important advances. This country has never been lacking in men of genius whose inventive capacity can give birth to the ideas which bring about industrial advances. What is new, in this country, in present times is the way in which industry has taken up these new ideas and brought them to the stage of industrial application by team work in which the scientists, the technical men and in fact all the departments into which a great business is organised have worked side by side in the practical attainment of an objective."

The future, the report continues, no longer lies with industries content to make sporadic advances at the call of the brilliant individualist. Co-operation, team work and an extensive organisation on the technical side are essential for success.

Progress of the research associations

For this reason the Department attaches great importance to the development of the Co-operative Research Associations formed under the scheme launched in the early days of its existence. The steady increase in the sum which industry is providing each year for their development gives, the report states, a good reason "for taking an optimistic view" of their future. In the last three years this sum has increased by 40 per cent from £167,370 to £232,468. In the same period, the grants from the Department for these organisations have increased from £68,212 to £107,451. The year has also afforded other practical evidence of a forward movement in industry regarding research.

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In spite of such advances, the report, however, still regards the position of the Research Association movement as a whole as not yet entirely satisfactory. The Department is prepared to provide a further £66,000 each year to the support of the Research Associations, and would have been prepared to find that sum in each of the past two years had industry been ready to provide an equivalent contribution. In fact, the income of the associations might have been increased by a further £150,000 a year of which only half had to be found by industry, if full advantage had been taken of the Department's offers which have been made to and accepted by various Research Associations.

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SAVINGS IN THE MILK INDUSTRY

A striking example is the work the Department is carrying out with the co-operation of the Milk Marketing Board on the purification of waste waters and effluents from milk depots, creameries and condensed milk factories. Two different methods have been worked out, and shown to be successful on a large scale, by which the polluting character of milk washings can be reduced by 99 per cent and 97 per cent respectively. Investigations have also drawn attention to the losses of milk, cream, whey, etc., carried away in the waste waters. It has been shown that the wastes from this cause can be reduced by nearly three million gallons per year. At the low wholesale price of *5d.* a gallon for milk for manufacturing purposes, this means, the report points out, a saving of about £50,000 a year to the industry. Five per cent of the total quantities of by-products, whey, skimmed milk, etc., is frequently lost at present in the waste waters. This loss can be reduced to about 2 per cent. The suggestions put forward for reducing these wastes have already been adopted at several factories.

The summary included in the report of the work carried out in the laboratories of the Department and of the Research Associations during the year again reveals the infinite variety of the subjects covered by the Department's activities.

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THE TRANSPORT AND STORAGE OF FOOD

At the Low Temperature Station, Cambridge, the effect of radiation from radio active substances in destroying bacteria are being studied in connection with the storage of meat.

Methods of storing eggs in different concentrations of carbon dioxide are being tried out on a large scale. A high concentration of, say, 60 per cent prevents attack by mould and gives an excellent yolk but a very fluid white.

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Experiments have been made on the "gas storage" of pears. British Conference pears have been stored in refrigerated chambers with the atmosphere adjusted to contain the correct amount of carbon dioxide for long periods, extending well into the summer. When removed from the store the flavour, texture and appearance of the pears were entirely satisfactory.

Results are given of experiments on the gas storage of Williams' Bon Chrétien pears. Normally this variety is very difficult to market because it ripens quickly at ordinary temperatures and remains in an eating-ripe condition for only a few hours. By gas storage, in an atmosphere containing 2·5 per cent oxygen and 5 per cent carbon dioxide at 34°F., the fruit was held in a marketable condition until the middle of March. On removal from the store at this date, the report states, that

the pears ripened to a good quality in just over a week and remained in an eating-ripe condition for two or three days. The correct conditions for gas storage have been maintained on a commercial scale in a 30-ton experimental gas store.

Excellent results under commercial conditions have been obtained by improved methods for the preservation of peas by freezing. Quick cooling and freezing following blanching in hot water are essential and the colour and flavour are improved by the addition of just the right amount (0·1-0·15 per cent) of sodium carbonate.

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In connection with research on cotton it is stated that the new buildings of the Cotton Research Association include two large weaving sheds for experiments on cotton and rayon respectively. A plant for controlling the humidity of the air has been included in both sections. The cotton section has a simple plant by which humidities between 65 and 75 per cent at 70°F. can be maintained throughout the year. The effect of humidity on the weaving of rayon is not so well known and is to be studied in the new shed where the cooling plant installed allows humidities as low as 50 per cent to be maintained.

Intensive research is in progress on the chemical action of light on dyed cotton fabric. Some dyes apparently cause the fabrics to disintegrate, while others seem to protect them. The report states that

> "The growing belief of the cotton industry in scientific research and in the capacity of the Shirley Institute to apply research results to industrial processes is resulting in still heavier demands on the Association, so that it seems not unlikely that further increases in resources, space and personnel may have to be contemplated at no very distant date."

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Wool.—Extensive trials of the process for producing unshrinkable wool developed by the Wool Research Association are proceeding under semi-manufacturing conditions in a specially erected plant. This plant is being used for the instruction of the operatives of firms working the process, plans for the commercial release of which are now being considered.

Consideration has been given during the year to the need of some more satisfactory means than the present voluntary levy for raising funds for extensions in the work of the Wool Research Association, the necessity for which is generally recognised.

The desirability of a broader basis of organisation is emphasised by the movement now underway in the wool producing countries of the Empire, towards research on the better production of wool. Co-operation between manufacturers and producers is essential, the report states, if the future of wool is to be assured by

all the resources derivable from science. An example of work now in hand which is of importance to both sheep-breeders and manufacturers, is the investigation of methods for the quantitative measurement of wool quality.

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The Rubber Research Association is working on the development of durable rubber for gas masks, and is devising tests which should ensure supplies of reliable articles to be available should necessity arise. Among other subjects the association is studying the resistance of rubber and the improvement of rubber for shoe soles and heels.

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FIRST INTERNATIONAL CONGRESS OF AGRICULTURAL PRESS, BRUSSELS, JULY 1935

THE General Secretary of the International Committee of the Agricultural Press has communicated the Resolutions passed by the 1st International Congress of Agricultural Press held at Brussels on 26-27th July 1935, which are published below. We are informed that, following these Resolutions, an International Federation of Agricultural Press has been established at Rome, *Via* Regina Elena 86.

RESOLUTIONS

Considering the importance and necessity of a strongly organized agricultural press and taking into account the great services that this press has rendered and is still capable of rendering to agriculture, the 1st International Congress of Agricultural Press has approved the resolutions hereunder reported.

Be it resolved :

(*1*) That in accordance with the example given by certain countries, agricultural journalists should organize themselves under a legal status, so as to form a union among all those who have an interest in their profession ;

(*2*) That in all the countries there should be compiled a list of agricultural publications, containing the names of the principal editors and contributors ;

(*3*) That the groups of agricultural press should take all proper measures to give their readers, in the shortest possible time, all useful information concerning their profession ;

(*4*) That public authorities, great associations and their leaders should unite their efforts, in common with the interested groups of agricultural press, in order to favour the diffusion of agricultural press in their own countries ;

(*5*) That there be given the agricultural press the place it deserves in all agricultural events and other kindred occasions ;

(*6*) That the daily press should be induced to take an interest in the spreading of agricultural ideas, by publishing special pages or issuing supplements on agriculture, under the editorship of technical agriculturists ;

(*7*) That in the countries, where the agricultural press is well organized, there should be observed, at regular intervals, "an Agricultural Press Day," with the object of showing the importance of this press ;

(*8*) That the railway companies should grant to agricultural journalists all travel facilities needed for the accomplishment of their task ;

(*9*) That an International Card of Agricultural Press should be issued, subject to delivery only by the associations recognized by the International Federation of Agricultural Press (F. I. P. A.) ;

(*10*) That agricultural libraries should be established in the countries where they are not yet in existence ; such libraries to serve as centres of documentation and intellectual intercourse among journalists. It is believed that they would render invaluable services ;

(*11*) That the establishment of national groups of libraries specialized in agriculture should be recommended in the countries where these groups do not yet exist, and there should be likewise recognized the importance of a close co-operation among libraries ;

(*12*) That there be established an International Committee of Agricultural Librarians under the auspices of the F. I. T. A. and of the International Federation of Librarians Associations. The object of this Committee will be to further international intercourse among agricultural libraries, through co-operation and mutual aid in everything pertaining to the work of common interest.

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FIRST GUIDE TO AGRICULTURAL LITERATURE

THE following communication has been received from the Press Bureau of the International Institute of Agriculture, Villa Umberto, Rome :—

The Library of the International Institute of Agriculture in Rome, one of the leading centres of world literature in agriculture and allied subjects, has compiled and published a complete list (1) of current bibliographical sources, which are available for these subjects in all the various countries of the world. Considering the overwhelming output of printed matter in form of books, bulletins, reports, periodicals, etc., the importance of bibliographies is quite evident. They are the keys which unlock the immense wealth of literary production. The compilation of a complete list of existing bibliographical sources is therefore an event of considerable importance not only for the agricultural research worker in the strict sense but also for the scientists of the many fields which deal indirectly with agricultural matters.

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(1) A survey of current bibliographies on agriculture and allied subjets.—Rome, 1937 Price 10 Liras.

The newly published list is the outcome of co-operative work of the staff of the Institute's Library and the International Committee of Agricultural Librarians recently founded. The final arrangement and the text of the notes, which give a detailed description of the contents, scope, inclusiveness, classification and other features of each bibliography, is the work of Mr. V. A. Schaefer, under the direction of Dr. S. V. Frauendorfer, Chief Librarian of the Institute.

The list contains not only pure title bibliographies, but also abstracting journals and bibliographical sections, contained in other periodicals or annuals. The titles are arranged by countries of publication. A separate section includes publications of International Institutions. An alphabetical subject index and a title index facilitate greatly the use of the list, which gives information on more than 200 titles of 26 different countries. The publication is bilingual, English and French combined.

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WORLD COTTON REPORT ISSUED BY THE INTERNATIONAL INSTITUTE

THE following communication has been received from the Press Bureau of the International Institute of Agriculture, Villa Umberto, Rome :—

A survey of World Cotton Production and Trade covering all important countries in the world has just been issued by the International Institute of Agriculture at Rome. This is the first of a series of monographs on the principal agricultural products in the world market, the product of a new type of work at the Institute which has resulted from a recommendation of the United States Delegation in 1934. The new report presents the results of a study of the geography of cotton production up to 1936, the evolution of world trade, the status of the cotton manufacturing industry in the principal countries and an appraisal of the cotton policies of the various Governments, particularly of the United States.

A recovery of the world cotton market depends, in the opinion of the Institute, upon the abandonment in all countries of the tendency towards economic isolation and a positive attempt by the nations to bring about a greater degree of international economic co-operation.

The changes in cotton production and marketing in the United States during recent years under the Federal Farm Board and the Agricultural Adjustment Act are analyzed in detail and their effects upon world cotton trade are pointed out.

The American cotton policy which aimed at overcoming the cotton crisis by maintaining prices at an artificially high level at a time when the world was more impoverished led the lesser producing countries to devote, within the framework of their national economies, a greater attention to the cultivation of cotton and to participate more intensively on the international cotton market. The same result

ensued from the commercial policy of the United States, which closed that market to European goods, obliging the European textile industries to obtain their supplies from new sources.

Practical conditions of trade made almost impossible the disposal of the enormously increased production. In consequence stocks mounted up and the world was faced with an over-abundance of goods and an alleged overproduction. But instead of going back to the original causes of this situation, and instead of modernising the channels of the economic system for the circulation of goods, stimulating thus the international exchange of goods, the world proceeded to an amputation of agricultural production and the diminution of economic wealth.

The United States is still to determine the extent of its participation on the international cotton market. Nevertheless, in view of the continual development of the cotton producing centres and the appearance on the world market of new permanent cotton supplying countries, for which cotton has become an integral part of the national economy, the position of the United States on the world cotton market may become less secure.

From the point of view of a rational world economic system, it would be a real progress if all the branches of agriculture and all industrial activities could be developed in those parts of the world which were most suitable. It follows that it could only be of good augure if the United States, in which both the cultivation of and trade in cotton have developed in such striking fashion, notwithstanding the defects we have already indicated and which are now gradually being removed, could regain the place on the world market which is its full right.

The report carries statistics, maps and charts illustrating production and marketing in the principal cotton countries which make it of the most comprehensive manuals and handbooks of the cotton industry available.

NOTE.—This Report, p. 462, is distributed by the International Institute of Agriculture, Rome, Italy, price 30 Liras or $ 1·50 (postage 25 cents).

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DERRIS CULTURE IN THE FAR EAST

THE following communication has been received from the Press Bureau of the International Institute of Agriculture, Villa Umberto, Rome, March 1937 :—

As part of its program for the study of present-day agricultural problems in view of the increasing importance of pest destroying " roténone " products, the International Institute of Agriculture of Rome has published a short well-documented article dealing with the present state of the cultivation in the Far East of the Derris plant, which is the principal source of " roténone ".

The article appeared in the International Review of Agriculture. Its interest is enhanced by the fact that the Institute, through an inquiry made in the principal Derris producing countries, was able to get a large documentation in regard to the culture of this product. The documentary information came chiefly from governmental sources, and is supplemented by an important bibliography.

The subject has been divided into two parts :—the present state of Derris culture in Malasia, Dutch India, Borneo and the Philippines ; and an estimate of the value of Derris powder as an insecticide.

This latter section is of great interest, because, up to the present, the subject had not been accurately studied. The researches which have been made will undoubtedly facilitate for the consumer the procuring of a good quality of this product.

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SPINNING TESTS ON MIXTURES OF STAPLE FIBRES AND INDIAN COTTONS

Dr. Nazir Ahmed, Director of the Technological Laboratory, Indian Central Cotton Committee, has written an interesting report (Technological Bulletin Series A, No. 36) on spinning tests carried out on mixtures of staple fibres and Indian cottons. In the introduction it is pointed out that the past few decades have witnessed a large increase in the use of artificial fibres as a supplement to or substitute for natural fibres, in which rayon silk has held the first position. Rayon produced in short definite lengths, called staple fibre, went up from eight million pounds in 1931 to twenty-one million pounds in 1932 and then to 156 million pounds in 1935 which represented fifteen per cent of the total rayon output. This large increase is attributed to the fact that staple fibre possesses uniform length and cross section, it is clean and therefore there is very little waste and it does not adhere to the machine. But the more important reason is that it can be mixed and blended with cotton, wool flex and silk and spun on the existing machines with some minor adjustments. The spinners, weavers, dyers and finishers can therefore produce a wide range of effects with it.

In view of the increasing importance of the staple fibre to the cotton textile industry some preliminary tests have been made using three types of staple fibre and two well-known varieties of Indian cotton.

The material used for the tests were : (1) Cottons—two standard Indian cottons, *viz.*, Jayawant and Combodia Co. 2 ; (2) Staple fibres—three types of staple fibres A, B and C were used. These were about 1·5 deniers per filament and their staple lengths ranged between 1·20″ to 1·44″. They were mixed with the cottons at the back of the first head of Draw Frame in the proportion of 1 : 2 and 2 : 1 and were spun into 20's and 30's counts with 3½ and 4 twist multiples,

the pure cottons and the pure staple fibres also being spun in the same counts for purposes of comparison.

The conclusions drawn from the results of the various tests made on the fibres and the yarns are as follows :—

(1) *Yarn breakages*

The three staple fibres gave practically no breakages and their mixtures gave fewer breakages than the pure cottons. This was specially the case with the staple fibre A.

(2) *Yarn evenness*

The yarns from the three staple fibres were much superior to the cotton yarns in evenness and with an increase in the proportion of staple fibres in the mixture the evenness of the yarns improved.

(3) *Yarn neppiness*

The staple fibre yarns are absolutely free from neps and have a very smooth appearance. This property is transferred to the mixture yarns, although yarn neppiness does not follow the simple additive law.

It is suggested that other considerations permitting the admixture of a small quantity of staple fibre may be used for reducing yarn breakages or yarn neppiness or improving yarn evenness in special cases.

(4) *Yarn strength and yarn extension*

(*a*) *Staple fibres.*—In these yarns a comparatively low lea strength is found to be associated with a much higher ballistic test than is met with in cotton yarns. The staple fibre yarns, however, have a much higher extensibility than cotton yarns and the twist required to attain the maximum strength is lower than that for the cottons used in these tests.

(*b*) *Effect of increasing the proportion of staple fibres in the mixtures.*—If the proportion of staple fibres is increased in the mixture, the lea strength and the single thread strength of the yarns spun from it decrease while the ballistic work of rupture and the percentage extension increase. The decrease in the lea strength is generally greater in magnitude than the increase in the ballistic work of rupture.

(*c*) *Mixtures of staple fibres and cotton.*—Different cottons responded differently depending upon their ballistic work of rupture and mean fibre-length. The strength result of the mixtures were influenced by the disparity between the mean lengths of the cotton and staple fibre ; the smaller the disparity the better the results.

The bulletin gives full details of the machinery employed in these tests and the results obtained are described and discussed in detail. It is hoped that it

will be found useful by the industry. It can be had from the Secretary, Indian Central Cotton Committee, Vulcan House, Nicol Road, Ballard Estate, Fort Bombay, at As. 8 per copy.

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THE MAYNARD-GANGA RAM PRIZE

In 1925 the late Sir Ganga Ram, Kt., C.I.E., M.V.O., R.B., Lahore, with that generosity for which he was so well known, handed over to the Punjab Government a sum of Rs. 25,000 for the endowment of a prize of the value of Rs. 3,000 to be called the Maynard-Ganga Ram Prize and to be awarded every three years, for a discovery, or an invention, or a new practical method which will tend to increase agricultural production in the Punjab on a paying basis. The competition is open to all throughout the world. Government servants are also eligible to compete for it.

The first award which was due in 1929 was made in 1931 to Dr. Barber, late Imperial Sugarcane Expert, for his fundamental discoveries which resulted in the production of Coimbatore sugarcane. During the last five years no further awards have been made owing to lack of suitable entries concerning which sufficient information was available. The 1932 award has now been made by the Managing Body to Mr. T. A. Miller Brownlie, late Agricultural Engineer to Government, Punjab, for his invention of a slip strainer suitable for water augmentation supplies derived from bores sunk in open wells. This strainer has the particular merit that it is not affected by alkaline sub-soil water—a defect from which many of the earlier metal strainers suffer. The new strainer is also cheaper than the former types in use. It has been tested now for several years in a large number of wells and has given excellent results. By its use owners of well-irrigated lands can increase the output of water from their wells. Consequently they can grow a larger area of crops on wells so equipped and a greater range of better-paying crops.

Meantime the 1935 award fell due. The Managing Body has awarded it to Rai Sahib Jai Chand Luthra, I.A.S., Professor of Botany, Punjab Agricultural College, Lyallpur, for his new method of treating wheat seed in order to free it from a fungal disease called 'loose smut'. This disease is present in most parts of the Province and causes considerable loss to cultivators. The old method of treatment involved the use of a thermometer and required skill and accuracy in raising water to a temperature which was sufficient to kill the spores of the disease inside the wheat grain and yet not damage the germinating power of the grain. Consequently, the method was unsafe in the hands of unskilled and illiterate people. By Rai Sahib Jai Chand Luthra's method the use of a thermometer is rendered unnecessary. The wheat seed to be treated is merely soaked in water at ordinary

temperature for four hours during the morning of a day in summer. Thereafter the soaked grain is spread in the sunshine till it is thoroughly dried. Experience has shown that this treatment is effective in controlling the disease without damaging the germinating power of the seed. It can be carried out safely by any illiterate worker.

Entries for the next award should reach the Director of Agriculture, Punjab, Lahore, on or before the 31st December, 1938.

ABSTRACTS

The pulse beetles (*Bruchidae*) of Burma. C. C. GHOSH (*Ind. J. Agric. Sci.* **7**, 395)

THE author records the occurrence of *Bruchus chinensis* L., *B. analis* F., *B. phaseoli* Gyll. and *B. albocallosus* Pic. on different cultivated peas and beans, the first three both in field and store and the fourth only in the field.

Occurrence of *Araecerus fasciculatus* De G. is also noted but this and the last-named species of *Bruchus* are not considered as pests. The first named three species of *Bruchus* are pests and have been studied and tried on all sorts of peas and beans in order to find out whether they could breed on them. While ordinarily *B. chinensis* behaves as a pest on *Cajanus indicus* and cowpeas, *B. phaseoli* on *Dolichos* spp. and *B. analis* on cowpeas and *Phaseolus mungo* and *P. radiatus*, all the three can breed on many other seeds. Some seeds are however immune to all of them. Steeping large seeds in water in order to eliminate affected ones, thorough sunning and storage under sand are suggested. (*Author's abstract*)

An anthracnose disease of sann-hemp. M. MITRA. (*Ind. J. Agric. Sci.* **7**, 443)

A DISEASE of sann-hemp causing serious damage to young seedlings was noticed for the first time at Pusa during August 1935. The causal organism was found to be *Colletotrichum curvatum* Briant and Martyn, previously recorded from the West Indies. The infection experiments carried out proved its pathogenicity. The disease is very virulent during the seedling stage of the host plant and especially if seed is sown late when the weather is moist and cloudy. The early-sown crop generally escapes the disease and with age the plant becomes less susceptible to infection.

Under favourable conditions of temperature and moisture the complete cycle from infection to spore production may occur within a few days. Conidia are produced abundantly even on small lesions and in periods of high humidity they are produced in enormous quantities on newly developed lesions as well as on dead plants. The most serious factor is local spore distribution by spattering rain as the conidia are carried to healthy parts or to other plants by rain.

The treatment of seed with disinfectants checks the disease. Spraying with fungicides has been found to be helpful if carried out in dry weather. (*Author's abstract*)

A genetical study of roots in relation to disease resistance in cotton. V. G. PANSE, and A. F. PATEL (*Ind. J. Agric. Sci.* **7**, 451)

A RAPID method of exposing and examining roots of cotton plants is described.

A long tap-root, a large number of laterals in the lower regions and a small number of laterals in the upper region are shown to be associated with greater resistance of

certain varieties to root-rot. Similar differences are shown to exist between resistant and un-selected plants within the cotton variety Broach 9. Such differences within a strain justify single plant selection based on desirable root characters. (*Authors' abstract*)

Studies on the stinking smut or bunt of wheat in India. M. MITRA (*Ind. J. Agric. Sci.* **7**, 459)

IN order to find out the effect of *T. indica* Mitra on the ears of wheat plants, bunted ears of several varieties of wheat were collected at random from Karnal during 1934-35 and 1935-36. The length of ears and the number of spikelets in each ear were noted and compared with normal ears which were also collected at random. It was found that like the other two species of *Tilletia* occurring on wheat, this species also causes reduction in the length of the ear. Moreover the number of spikelets is also reduced. During 1935 completely bunted ears were noticed for the first time.

Experiments carried out during 1934-35 to find out the effect of some of the fungicides, hot water, solar energy and sun-heated water show that the percentage of infection by *Tilletia indica* reduced considerably but the disease cannot be completely controlled by the treatment of seed only. Thus previous conclusions (Mitra, 1935) are confirmed. It was also noted that bunt infection can take place to a certain extent if healthy seed is sown in infected soil. The use of fungicides such as Agrosan G, Hortisan A and sulphur reduces the incidence of the disease even if the seed is sown in infected soil. Use of sulphur may be preferred on account of its cheapness and easy availability. As soil infection does take place crop rotation is strongly recommended. Further it has been observed that bunt does not appear in Pusa even if wheat is sown on infected soil. (*Author's abstract*)

Motes in cotton. 2. Punjab *desi* cottons. MOHAMMAD AFZAL (*Ind. J. Agric. Sci.* **7**, 487)

THE number and position of motes in the locks of the three most important *desi* varieties of cotton grown in the Punjab, namely, 10 Rosea, 12 Sanguineum and 15 Mollisoni were determined during 1931 and 1932.

The total number of motes in all the three varieties of *desi* cottons was far less in comparison with the American cottons, but the disposition of the motes in the various seed positions was very similar. The number of motes was least in the centre of the locks.

The early and late pickings had a greater number of motes than the middle pickings.

It has been suggested that by far the most important cause of the production of motes was the defective nutrition of the individual developing ovules inside the ovary. Field observation on pollination and microscopic studies of the sections of motes lend a great deal of support to this view. (*Author's abstract*)

The development of the microspores in *Trichosanthes dioica* Roxb. I. BANERJI and M. C. DASS (*Ind. J. Agric. Sci.* **7**, 497)

IN the resting condition of the pollen mother cells some dark staining bodies are found adhering to the nuclear membrane. During prophase these bodies appear to lie scattered on the leptotene threads and appear as dark spots. In the open spireme stage these bodies are not seen but a few comparatively bigger bodies are noted on the spireme. In the subsequent stages of meiosis these bodies could not be traced.

. Lateral approximation of the leptotene threads is noted in early prophase and becomes marked during synizesis. During pachynema the double nature of thread is difficult to make out but it is apparent during the second contraction stage. The bivalent chromosomes are formed as a result of the segmentation of the spireme. Evidence has been adduced to show that the method of chromosome conjugation is parasynaptic in this plant. Eleven bivalent chromosomes have been noted during the heterotypic division, no heteromorphic pair being present. The homotypic division is normal. Cytokinesis takes place by the process of furrowing.

Dark-staining bodies have been noted in the cytoplasm of the pollen mother cells during the heterotypic and homotypic divisions. These bodies are not all of equal size and their number also appears to be variable. Prior to cytokinesis these bodies arrange themselves more or less around the nuclei and eventually get distributed in the young pollen grains.

The chromosome numbers of both the male and the female plants were determined from the root tip cells. The somatic number was found to be $2n = 22$, in each case. The chromosomes of the female plants are slightly bigger than those of the male. (*Authors' abstract*)

On the Pyrilla pest of sugarcane in India. HEM SINGH PRUTHI (*Ind. J. Agric. Sci.* **7**, 511)

IT is believed that sugarcane is attacked by three species of *Pyrilla*, viz., *P. perpusilla* Walk., *P. aberrans* Kirby, and *P. pusana* Dist., in various parts of India. A careful study of the three species occurring at Pusa has revealed that they actually include only one, or at the most, two species. True *P. aberrans* Kirby is not found in India, except perhaps in its extreme south, and the species usually referred to as this species is actually *P. pusana* Dist. This conclusion is based on biological as well as morphological studies which are described in the paper. (*Author's abstract*)

Haematological studies in Indian dairy animals. N. S. SANKARANARAYANAN (*Ind. J. Vety. Sci., & Anim. Husb.* **7**, 97)

A STUDY of blood elements of cattle of Bangalore farm was made to fix Haematological standards for Indian dairy cattle.

The advantages and disadvantages of using anticoagulant for collection of blood samples for examinations have been fully discussed. Mention has also been made of the merits of sodium citrate solution as the diluting fluid for the red cell pipette.

Average counts of different breeds of cattle including buffaloes are given in a tabulated form. The erythrocytes and leucocytes are found higher in Indian cattle than European cattle but half-bred animals give figures agreeing with European cattle. Among Indian cattle, buffaloes give the highest counts, the average of the red cells reaching 11·0 millions and the leucocytes 20·0 thousands.

Indian cattle—red cell counts 8·0 to 9·0 millions.

Half-bred cows—red cell counts 6·876 millions.

Buffaloes—red cell counts 9·682 millions.

From a study of the differential counts made on the animals, it is noticed that the different forms of leucocytes exist in the same proportions in all healthy cattle, the proportion being about 30 per cent Polymorpho nuclears, 10 per cent Eosinophiles and 60 per cent of Mononuclears consisting of both large mononuclears and small lymphocytes. Basophiles are found to be absent in healthy cattle. (*Author's abstract*)

A check-list of the nematode parasites of the domesticated animals in Burma.

J. Bhattacharjee (*Ind. J. Vety. Sci. & Anim. Husb.* **7**, 87)

The article gives a systematic and an up-to-date record of the nematode parasites of the domesticated animals in Burma, the latter comprising elephant, cattle, buffalo, sheep, goat, horse, mule, dog, cat, and pig. Four families, out of the fourteen recorded, have not been previously recorded, *viz.*, Acuariidae, Gnathostomidae, Physalopteridae, and Syngamidae. Out of the thirty genera and forty-six species recorded, the following have not been previously recorded :—

Ascaris lumbricoides, Gnathostoma spinigerum, Habronema muscae, Mecistocirrus digitatus, Nematodirus filicollis, Oesophagostomum venulosum, Onchocerca armillata, Parabronema smithii, Parascaris equorum, Physaloptera praeputialis, Setaria digitata, Syngamus laryngeus, Thelazia lacrymalis, Thelazia rhodesii, Toxocara canis.

All the parasites recorded in this article, unless specified therein, were identified by the writer, and references to the literature cited. The parasites identified were from the collections of the Veterinary Research Laboratory, Insein, Burma. (*Author's abstract*)

REVIEWS

Scientific Horticulture (Formerly the H. E. A. Yearbook)—The Journal of the Horticultural Education Association, Vol. V, 1937 (Price 3*s*. 6*d*. net, postage 5*d*. extra, obtainable from the Editor, Scientific Horticulture, South Eastern Agricultural College, Wye, Kent, England.)

THE Horticultural Education Association produce a yearly publication which used to be called the H. E. A. Yearbook but is now entitled Scientific Horticulture. The 1937 issue is Volume V, a compact book of about 200 pages containing some twenty excellent articles on various aspects of horticulture. The subject matter of these articles, the high level of horticultural technique revealed and the character of the membership of the Association as shown in the list of members and associates at the end of the volume show clearly how advanced are the science and practice of horticulture in Great Britain.

A short review of the changes in the work of a County Horticultural Officer in the last 25 years is described by the President, Mr. C. J. Gleed, Horticultural Superintendent, Hampshire, in his Presidential Address which occupies the first two or three pages. He indicates, however, that there is still no research station for dealing with vegetable problems on the same comprehensive lines as those for fruit and that such a station is urgently needed. He also indicates the great changes that have taken place in the qualifications now looked for in a county adviser. In the old days practical gardening experience was everything. Now-a-days scientific training is essential and there is perhaps a tendency to discount the value of practical experience. Another interesting change is the increase of work due to the development of school gardens and playing fields and the general increase in social amenities for which local authorities are responsible.

It is impossible to do more than briefly indicate some of the articles which have interested the reviewer. There is for example an article entitled "The Death"—a trouble of fruit trees due to root suffocation not always caused in one way, one of the unusual forms being death from *wind-rocking* due to the trees being moved about excessively by high winds, with consequent damage to that part of the root just below the collar. The physiological side is well dealt with in several papers including an interesting one on 'Bud Dormancy' by Prof. R. H. Stoughton, Professor of Horticulture, University of Reading, and an article on "Plant Hormones" by Meirion Thomas, Department of Botany, Armstrong College, Newcastle-on-Tyne. This is a very fascinating line of work which has been developed largely due to the efforts of Dutch and American workers. The

photographs given with this article show some rather astonishing results. Mr. R. B. Dawson, Director, St. Ives Research Station at Bingley, Yorkshire, contributes an excellent article on "The Routine Management of Lawns." The St. Ives Research Station is the experiment station of the Board of Greenkeeping Research which has for some years been doing admirable work in the application of science to the production of perfect grass surfaces particularly for games, the most exacting requirements naturally being those of the high class modern golf-green. Photographs here again are good and convincing. While dealing with the subject of grass, reference should be made to page 195 of the book under review where the first number of a new journal entitled "The Agrostologist" is announced. This is edited and published by two former members of the staff of St. Ives Research Station and ought to have a wide circulation among those interested in sports grounds and lawns but also among those interested in grass from the pure scientific side. [W. B.]

The Hindu 'Jajmani' System—a Socio-economic System Inter-relating Members of a Hindu Village Community in Services. By W. H. WISER, M.A., PH.D. (Lucknow Publishing House, 1936).

AN American Sociologist and Economist, who with his wife has devoted many years to a study of village life in India and to missionary work largely amongst the 'untouchables', Dr. Wiser is known to many interested in rural uplift work in Northern India as a shrewd but sympathetic observer. As a result of many seasons spent in a simple camp in a U. P. district he has been able to describe the organisation of a village community, as seen by a Westerner, with unusual clarity and precision. He gives details of the caste-occupational system, of the traditional services rendered by villagers to each other and the payments in kind made for them and finally concludes with some interesting speculations on the effect of the caste-occupational system on rural development. When he urges the need of a thorough study of the system by rural reformers he is on firm ground and there is much in his contention that frequently the rural uplift worker would achieve more rapid results if he could rally the natural leaders of a village to his aid. He makes it equally clear, however, that any hereditary occupational system tends to accentuate existing inequalities rather than to remove them. As an economic study the book would have been more valuable had it included an analysis of the status of the different castes in relation to land. Various passages suggest that the higher caste 'Jajmans' in the village under study were mainly occupancy tenants of an absentee landlord cultivating their land with the help of village labour and probably sub-letting a part. A clear picture of the land tenures and some description of the holdings and cropping would have been a valuable addition. Perhaps one may hope for this in a future edition. [B. C. B.]

***Kitab-ul-falahat*, Vols. I and II.** BY ABU ZAKARIYA YAHYA BIN MOHAMAD ESHBELI. Translated from Arabic into Urdu by Sayyad Mohammad Hshim Nadawi. Price of Urdu translation Rs. 8. Obtainable from the Manager, Darul-Musannefeen, Azamgarh, United Provinces.

THE original was in Arabic, compiled in Spain, in eighth century, by Abu Zakariya Yahya. It has been translated into Urdu and printed at the cost of the Government of His Exalted Highness the Nizam. It is a comprehensive book covering 1,122 pages. The compilation is based on extracts from the works of more than thirty Greek and Spanish experts in agriculture and on the experiences of the compiler himself.

The book comprises 30 chapters on agriculture and four on animal husbandry and a large variety of subjects are dealt with in the light of writings of earlier authors. For instance, on soil, there are discussions on its nature, reclamation, improvement, management, etc. On manure, there are discussions on its preservation, preparation of mixtures, application, effects, etc. On water, there are discussions on water-finding, well-sinking, water-lifting, irrigation, etc. On plants, there are given methods of cultivation, sowing, planting, pruning, exposure of roots, grafting, budding, layering, fertilisation, harvesting, threshing, storing and preservation of fruits and grains and preparation of fruit products. There are chapters on complete methods of growing various kinds of fruits, vegetables, flowers, spices, drugs and other field crops. On the animal husbandry side, the book contains short chapters on breeding and upkeep of cattle, horse, mule, donkey, camel, sheep, goat, fowl, pea-fowl, geese, duck and pigeons. There is also a chapter on bee-keeping. Insect and other pests and diseases of plants and animals are also discussed and methods of control and treatment are given. Agricultural meteorology and general management of the farm, garden and stable are also dealt with. Still more interesting is the fact that the book also contains a calendar of agricultural operations for all the twelve months of the year. A perusal of the book gives a good idea of the progress which had been made in those old days in the knowledge of agriculture, apart from its practice.

The book is full of numerous useful practical hints which should prove of interest to the educated agriculturists. Some statements in the book may appear strange to the modern scientist, but the compiler himself has said "All such things appear strange, but how can the compiler contradict the statements made by the ancient learned people in their books ?" The book has a great historical interest in any case.

The Urdu language of the translation is plain and simple, but unfortunately foreign Arabic terms have been used too freely and the glossary given at the end is incomplete. [N. H.]

NEW BOOKS

On Agriculture and Allied Subjects

THE Scientific Principles of Plant Protection, with special reference to Chemical Control. By Hubert Martin, D.Sc., F.I.C. Pp. xii+379. (London : Edward Arnold & Co., 1936.) Price 21*s*.

Scientific Horticulture (Formerly the H. E. A. Year Book), Vol. V, 1937. Pp. 196+xxxii. (Published by the Horticultural Education Association, Wye, Kent, England.) Price 3*s*. 6*d*. (postage 5*d*. extra.)

Recent Advances in Cytology. By Darlington, C. D. Ex. Cr. 8vo. Pp. xvi+67+16 plates. (London : J. & A. Churchill, Ltd., 1937). Price 21*s*.

An Introduction to Plant Physiology. By James, W. O. Third Edition. Cr. 8vo. Pp. viii+266. (Oxford : Clarendon Press ; London : Oxford University Press, 1936.) Price 7*s*. 6*d*. net.

Profit from Fertilisers. By Garner, H. V. and others. Demy 8vo. Pp. 182 (London : Crosby, Lockwood and Son, Ltd., 1936.) Price 7*s*. 6*d*. net.

A Practical Course in Agricultural Chemistry for Senior Students of Agriculture, Dairying, Horticulture and Poultry Husbandry. By Knowles, Frank, and Watkin, J. Elphin. Demy 8vo. Pp. ix+188. (London : Macmillan & Co., Ltd., 1937.) Price 10*s*. net.

The Organization of Agriculture with Applications to South Africa. By Leppan, Hubert D. Cr. 8vo. Pp. v+83. (Johannesburg : Central News Agency, 1936.) Price 4*s*.

A Handbook of Home-grown Timbers. Issued by the Department of Scientific and Industrial Research, Forest Products Research. Roy. 8vo. Pp. iv+47. (London : H. M. Stationery Office, 1936.) Price 1*s*. 6*d*. net.

Vegetable growing in New Zealand. By McPherson, J. A. and Pye, A. C. Cr. 8vo. Pp. 193. (Melbourne, Auckland and London : Whitcome and Tombs, Ltd., 1937.) Price 2*s*. 6*d*. net.

The Practical Bee Guide. A Manual of Modern Bee-keeping. By Digges, J. G. Eighth Edition. Demy 8vo. Pp. 312. (Dublin : The Talbot Press, Ltd. ; London : Simpkin Marshall, Ltd., 1936.) Price 4*s*. 6*d*. net.

The Evolution of the Australian Merino. By Cox, E. W. Cr. 4to. Pp. xxii+160+31 plates. (Sydney and London : Angus and Robertson, Ltd., 1936.) Price 21*s*.

Rations for Live-Stock. By Wood, T. B. and Woodman, H. E. Pp. 69. (London : Adastral House, Kingsway.) Price 1*s*. net (1*s*. 2*d*. post free).

Profitable Poultry Keeping in New Zealand. By Stewart, M. W. Cr. 8vo. Pp. 198. (Melbourne, Auckland and London : Witcombe and Tombs, Ltd., 1937.) Price 3*s*. net.

PLANT QUARANTINE AND OTHER OFFICIAL ANNOUNCEMENTS

BRITISH INDIA

Notification No. F. 116-34-A., dated the 8th April 1937, issued by the Government of India, in the Department of Education, Health and Lands.

In continuation of this Department Notification No. 360, dated the 29th February 1924, as subsequently amended, it is notified for general information that no charge will be made for the consignments of plants intended for export to countries abroad, which are sent to the Government Fruit Farm, Mirpurkhas, for inspection and certification provided that all incidental charges are borne by the exporters. Consignments may also be made available for inspection and certification work at Karachi. The Chief Agricultural Officer in Sind is authorised to charge a fee of Rs. 20 for each such consignment.

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UNITED STATES OF AMERICA

The following Regulations have been issued by the United States Department of Agriculture, Bureau of Entomology and Plant Quarantine :—

(1) Modification of Thurberia Weevil Quarantine Regulations. Revision of Regulation 3 : Effective October 22, 1936.

(2) Fruit and Vegetable Quarantine. Notice of Quarantine No. 56, with revised Regulations. Effective December 1, 1936.

(3) Service and Regulatory Announcements, July-September, 1936. Issued December 1936.

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JAMAICA

The following Government Notice No. 48, published in Jamaica Gazette, 21st January, 1937, is reproduced for general information.

Under Section 2 (8) of Law 23 of 1916

The transhipment of Citrus from Spanish Honduras and British Honduras at the Port of Kingston will be allowed in future on the following conditions :—

(a) The fruit must be clean and free from pest and disease.

(*b*) The fruit must have been properly processed and packed to the satisfaction of the Officer duly appointed to inspect it prior to transhipment.

(*c*) Transhipment must be direct from ship to ship and no storage of fruit, except in the ship by which it arrives, can be permitted pending transhipment.

(*d*) All fruit must leave the Island by ship (*i.e.,*) any broken or damaged boxes must be taken away and any fruit which may fall into the sea at the time of transhipment must be picked up by one or other of the vessels.

Personal Notes, Appointments and Transfers, Meetings and Conferences, etc.

The names of the following recipients of His Majesty the King Emperor's Coronation Honours will be of interest to the Agricultural and Veterinary Departments in India :—

K. C. S. I. : The Honourable Kunwar Sir Jagdish Prasad, C.S.I., C.I.E., O.B.E., Member of the Governor-General's Executive Council.

Knighthood : Colonel Arthur Olver, C.B., C.M.G., F.R.C.V.S., F.N.I., Royal Army Veterinary Corps (retired), Expert Adviser in Animal Husbandry to the Imperial Council of Agricultural Research (on leave).

C. I. E. : Mr. F. Ware, F.R.C.V.S., I.V.S., F.N.I., Officiating Expert Adviser in Animal Husbandry to the Imperial Council of Agricultural Research.

Sardar Bahadur : Sardar Datar Singh, Montgomery, Punjab.

Rai Bahadur : Mr. Ram Lal Sethi, M.Sc., B.Sc. (Agri.), M.R.A.S., I.A.S., Economic Botanist (Sugarcane and Paddy) to Government, Government Research Station, Shahjahanpur, United Provinces.

Rai Bahadur : Mr. Jatindra Nath Chakravarty, B.A., M.S.A., Dip. in Agri., Director of Agriculture, Assam.

Rai Bahadur : Dr. Karam Chand Mehta, M.Sc., Ph.D., Senior Professor of Botany, Agra College, Agra, United Provinces.

Rao Bahadur : Rao Sahib Nilgiris Sundaram Pillai Kulandaiswami Pillai, Dip. in Agri., Deputy Director of Agriculture, Madras Presidency.

Rao Bahadur : Rao Sahib Gangadhar Krishna Kelkar, B.Ag., Deputy Director of Agriculture, Southern Circle, Nagpur, Central Provinces.

Rai Sahib : Mr. Har Narain Batham, Agricultural Chemist to Government (retired), United Provinces.

Rai Sahib : Mr. Ram Subhag Singh, Bihar Agricultural Service, Bihar.

Rao Sahib : Mr. Gotety Jogiraju, Dip. Agri., Assistant Director of Agriculture, Madras Presidency.

Rao Sahib : MR. DAMODAR RAMCHANDRA MOHARIKAR, Officiating Deputy Director of Agriculture, Eastern Circle, Raipur, Central Provinces.

Imperial Council of Agricultural Research

THE HON'BLE MR. HOSSAIN IMAM has been elected by the Council of State as its representative on the Imperial Council of Agricultural Research.

The services of RAI BAHADUR R. L. SETHI, M.Sc., B.Sc. (Agri.), M.R.A.S., I.A.S., Officer on Special Duty (Agriculture), Imperial Council of Agricultural Research, have been replaced at the disposal of the Government of the United Provinces with effect from the afternoon of the 23rd March 1937.

The services of CAPTAIN A. C. AGGARWALA, A.I.R.O., M.R.C.V.S., B.Sc. (Hons.), Officer on Special Duty (Animal Husbandry), Imperial Council of Agricultural Research, have been replaced at the disposal of the Government of the Punjab with effect from the afternoon of the 2nd April 1937.

Indian Central Cotton Committee

The Governor-General in Council has been pleased to appoint the following gentlemen as additional members of the Indian Central Cotton Committee, Bombay :—

(1) RAO BAHADUR S. S. SALIMATH, Deputy Director of Agriculture, Bombay.

(2) MR. V. RAMANATHA AYYAR, Cotton Specialist, Coimbatore.

(3) SETH ISSERDAS VARINDMAL, representative of the Karachi Indian Merchants' Association.

(4) MR. CHELLARAM SHEWARAM, representative of the Karachi Cotton Association, Limited.

In the vacancy caused by the resignation of MR. H. H. PANDYA, the Durbar of the Gwalior State have nominated MR. G. K. LELE, Deputy Director of Agriculture, Prant Malwa, to be a member of the Indian Central Cotton Committee, Bombay, to represent that State.

In consequence of vacancies caused by the retirement of nominated members with effect from the 1st April, 1937, the following have been nominated to be members of the Indian Central Cotton Committee, Bombay :—

By the Indian Merchants' Chamber, Bombay—

MR. CHANDULAL P. PARIKH, to represent the Indian Merchants' Chamber, Bombay.

By the Ahmedabad Millowners' Association—

MR. KASTURBHAI LALBHAI, to represent the Ahmedabad Millowners' Association.

By the Government of Bombay—

SARDAR RAO BAHADUR BHIMBHAI RANCHODJI NAIK, to represent the cotton growing industry in the Bombay Presidency.

By the Karachi Chamber of Commerce—

MR. G. C. R. COLERIDGE, to represent the Karachi Chamber of Commerce.

By the Government of the Punjab—

MR. BALAK RAM, to represent the ginning and manufacturing industry in the Punjab.

By the Government of Madras—

MR. J. NUTTALL, to represent the cotton ginning and manufacturing industry in the Madras Presidency.

MR. V. C. PALANISWAMI GOUNDAR, to represent the cotton growing industry in the Madras Presidency.

Indian Central Jute Committee

MR. E. F. G. GILMORE, B.Sc., M.I.Mech.E., Acting Director, Industrial Research Bureau, has been nominated by the Governor-General in Council to be a member of the Indian Central Jute Committee, Calcutta, *vice* MR. N. BRODIE.

Indian Lac Cess Committee

Under the provisions of Section 4 (8) of the Indian Lac Cess Act, 1930 (XXIV of 1930), as amended by the Indian Lac Cess (Amendment) Act, 1936 (IX of 1936) the Governor-General in Council has been pleased to make the following appointments on the Indian Lac Cess Committee :—

(1) MR. W. F. DINES of Messrs. Angelo Brothers, Ltd., Calcutta, nominated by the Bengal Chamber of Commerce, representing the shellac

manufacturing industry, as a member of the Governing Body, *vice* MR. J. T. YOUNG, resigned.

(2) MR. HUBERT WIND of Messrs. the Gramophone Company, Ltd., Calcutta, as a member of the Governing Body and of the Advisory Board, *vice* MR. ANDREW FORBES, resigned.

Under the provisions of Section 4 (8) of the Indian Lac Cess Act, 1930 (XXIV of 1930), as amended by the Indian Lac Cess (Amendment) Act, 1936 (IX of 1936), the Governor-General in Council has been pleased to appoint MR. A. METAXA of Messrs. Ralli Brothers, Ltd., nominated by the Bengal Chamber of Commerce, representing the shellac export trade, as a member of the Governing Body of the Indian Lac Cess Committee, *vice* Mr. R. E. HAWKINS, resigned.

Imperial Agricultural Research Institute

DR. B. P. PAL, M.Sc., Ph.D., Second Economic Botanist, has been appointed Imperial Economic Botanist, Imperial Agricultural Research Institute, New Delhi, with effect from the 5th April, 1937.

Imperial Veterinary Research Institute

MR. W. TAYLOR, D.V.H., M.R.C.V.S., I.V.S., Principal, Punjab Veterinary College, has been appointed to officiate as Director, Imperial Veterinary Research Institute, Mukteswar, with effect from the 11th March 1937, *vice* MR. F. WARE, C.I.E., F.R.C.V.S., I.V.S., F.N.I., appointed to officiate as Animal Husbandry Expert, Imperial Council of Agricultural Research.

Madras

MR. M. SUNDARANATHAN, G.M.V.C., Veterinary Assistant Surgeon in the selection grade, and Officiating Lecturer in Pharmacology in the Madras Veterinary College, has been appointed to the Madras Veterinary Service, category 3 of Class I, and posted as Lecturer in Pharmacology with effect from the 19th March 1936.

Bombay

MR. M. N. KAMAT, Assistant Mycologist, has been appointed to be Assistant Professor of Mycology, Agricultural College, Poona, *vice* DR. M. K. PATEL, M.Sc., Ph.D., on leave.

DR. V. N. GOKHALE has been appointed to be Assistant Investigator, Dry-farming Research Scheme, *vice* DR. J. A. DAJI.

MR. V. R. PHADKE, G.B.V.C., J.P., Principal, Bombay Veterinary College, has been appointed to do duty as Director of Veterinary Services, Bombay Presidency, *vice* MR. E. S. FARBROTHER, proceeding on leave.

MR. M. MOHEY-DEEN, M.R.C.V.S., Assistant Professor, Bombay Veterinary College, has been appointed to act as Principal, Bombay Veterinary College, *vice* MR. V. R. PHADKE, appointed to do duty as Director of Veterinary Services.

MR. B. S. PATEL, N.D.D., N.D.A., C.D.A.D., has been appointed to act as Live-stock Expert to Government, *vice* MR. E. J. BRUEN, proceeding on leave.

Bengal

MR. A. D. MACGREGOR, F.R.C.V.S., F.Z.S., I.V.S., Principal, Bengal Veterinary College, has been allowed leave on average pay for the period from 1st July to 5th November 1937.

MR. J. M. LAHIRI, Vice-Principal, Bengal Veterinary College, has been appointed to act as Principal of the College, during the absence on leave of MR. A. D. MACGREGOR, or until further orders.

MR. F. J. GOSSIP, Live-stock Expert to the Government of Bengal, has been allowed leave on average pay for eight months, with effect from the 22nd March 1937, or any subsequent date on which he may avail himself of it.

MR. SAILENDRA NATH SINGHA, G.B.V.C., Lecturer, Bengal Veterinary College, has been appointed to act as Vice-Principal of the College, *vice* MR. J. M. LAHIRI.

MR. K. K. BANERJEE, Laboratory Assistant, has been appointed to act as Lecturer, Bengal Veterinary College, *vice* MR. SAILENDRA NATH SINGHA.

United Provinces

DR. B. L. SETHI, M.Sc., Ph.D., Assistant Paddy Specialist, Nagina, in the United Provinces Agricultural Service, Class II, has been appointed to be temporary Additional Economic Botanist (Cotton) in the United Provinces Agricultural Service, Class I, with headquarters at Cawnpore, with effect from the date of taking over charge.

Punjab

KHAN BAHADUR MAULVI FATEH-UD-DIN, M.B.E., B.A., M.R.A.S., A.R.H.S., I.A.S., Deputy Director of Agriculture, Jullundur City, has been granted leave on average pay for four months, with effect from 31st March 1937.

KHAN SAHIB CHAUDHRI MOHAMMAD ABDULLAH, I.A.S., Deputy Director of Agriculture, Hansi, has been granted leave on average pay for twenty-two days with effect from 4th March 1937.

MR. H. G. SADIK, B.A., Extra Assistant Director of Agriculture, Jullundur, has been appointed to be in charge of the duties of the Deputy Director of Agriculture, Hansi, with effect from 4th March 1937 in a temporary post and relieving KHAN SAHIB CHAUDHRI MOHAMMAD ABDULLAH, I.A.S., granted leave.

MR. H. G. SADIK, B.A., Extra Assistant Director of Agriculture (in charge of the duties of Deputy Director of Agriculture, Hansi) has been appointed to be in charge of the duties of Deputy Director of Agriculture, Jullundur City, with effect from 31st March 1937, relieving KHAN BAHADUR MAULVI FATEH-UD-DIN, M.B.E., B.A., M.R.A.S., A.R.H.S., I.A.S., granted leave.

MR. DARSHAN SINGH, Bar.-at-Law, M.R.A.C., F.R.H.S., M.R.A.S., I.A.S., Officiating Assistant Director of Agriculture, Punjab, Lahore, has been appointed to be Deputy Director of Agriculture, Gurdaspur, with effect from the 30th March 1937.

MR. D. P. JOHNSTON, A.R.C.Sc.I., N.D.A., I.A.S., on reversion from service under the Government of the North-West Frontier Province, resumed charge of the post of Assistant Director of Agriculture, Punjab, Lahore, on the 22nd March 1937, relieving MR. DARSHAN SINGH, I.A.S., transferred.

SARDAR SAHIB SARDAR LABH SINGH, L.Ag., B.Sc. (Agri.), Associate Professor of Agriculture and in charge of the duties of Professor of Agriculture, Punjab Agricultural College, Lyallpur, has been appointed as Professor of Agriculture, Punjab Agricultural College, Lyallpur.

MR. KARTAR SINGH, L.Ag., B.Sc. (Agri.), N.D.D., Assistant Professor of Agriculture, Punjab Agricultural College, Lyallpur, at present Temporary Marketing Officer, Punjab, Lahore, in the Punjab Agricultural Service, Class I, has been appointed as Associate Professor of Agriculture, Punjab Agricultural College, Lyallpur, with effect from 11th February 1937.

The undermentioned officers have been appointed permanently to the Punjab Agricultural Service, Class I, with effect from the 12th February 1936 :—

MR. B. S. SAWHNEY, Millet Botanist.

KHAN SAHIB CHAUDHRI ALI MOHAMMAD, Oil-Seed Botanist.

Bihar

LT.-COL. C. A. MACLEAN, M.B.E., M.C., M.A., B.Sc., Deputy Director of Agriculture, Tirhut Range, has been granted leave on average pay for two months and twelve days with effect from the 7th April 1937.

The services of MR. A. P. CLIFF, B.A., Dip. in Agri., I.A.S., Deputy Director of Agriculture, Tirhut Range, were placed at the disposal of the Government of India with effect from the 3rd December 1936 for appointment as Secretary, Indian Central Jute Committee.

The following officers, who were appointed on probation to Class I of the Bihar Agricultural Service, have been confirmed in their appointments, with effect from the 1st April 1937 :—

1. MR. BHUT NATH SARKAR, L.Ag., Deputy Director of Agriculture.
2. MR. H. W. STEWART, Agricultural Engineer.
3. MR. MAHBUB ALAM, M.Sc., Economic Botanist to Government.

MR. K. L. KHANNA, B.Sc., Sugarcane Specialist, has been appointed to officiate as Deputy Director of Agriculture, Tirhut Range, during the absence, on leave, of LT.-COL. C. A. MACLEAN or until further orders.

MR. KISHORI MOHAN GHOSH, who was appointed on probation to be Assistant Director of Agriculture and to Class II of the Bihar Agricultural Service, has been confirmed in his appointment, with effect from the 1st April 1937.

MR. PRABHAS CHANDRA GHOSH, B.Sc., who was appointed on probation to be Assistant Director of Agriculture and to Class II of the Bihar Agricultural Service, has been confirmed in his appointment, with effect from the 1st April 1937.

MR. H. W. STEWART, Agricultural Engineer, Bihar, has been granted leave on average pay out of India for six months and seventeen days, with effect from the 5th April 1937 or any subsequent date from which he may avail himself of it.

MR. SAIYID NASIRUDDIN AHMAD, Assistant Agricultural Engineer, has been appointed to officiate as Agricultural Engineer during the absence, on leave, of MR. H. W. STEWART.

MR. PRAKASH CHANDRA RAHIJA, Botanical Assistant, Sugarcane Research Station, Musheri, has been appointed to officiate as Sugarcane Specialist, during the absence, on deputation, of MR. K. L. KHANNA or until further orders.

MR. MUHAMMAD ISMAIL MALIK, B.Sc., M.R.C.V.S., Deputy Director of the Civil Veterinary Department, Bihar Veterinary Service, has been confirmed in his appointment with effect from the 1st April 1937.

Central Provinces and Berar

RAO BAHADUR G. K. KELKAR, B.Ag., Deputy Director of Agriculture, Southern Circle, has been granted leave on average pay for two and half months with effect from the 15th April 1937.

DR. R. J. KALAMKAR, Assistant Director of Agriculture, attached to the office of the Director of Agriculture, has been appointed to officiate as Deputy Director of Agriculture, Southern Circle, *vice* RAO BAHADUR G. K. KELKAR, on leave.

MR. K. P. SHRIVASTAVA, Extra-Assistant Director, in charge of the current duties of the post of the Second Economic Botanist, Central Provinces and Berar, has been granted leave on average pay for two months and fifteen days, with effect from the 5th April 1937.

MR. J. F. DASTUR, M.Sc., D.I.C., Officiating Principal, College of Agriculture, has been placed in charge of the office of the Second Economic Botanist, Central Provinces and Berar, in addition to his own duties, during the absence of MR. K. P. SHRIVASTAVA, on leave.

MR. R. H. RICHARIA, M.Sc., Ph.D., has been appointed, with effect from the 10th February 1937, as Plant Breeder for Oilseed Research Scheme, in the Central Provinces Agriculture Department, on probation for one year.

Assam

MR. SATYENDRA CHANDRA DATTA, L.Ag., Deputy Director of Agriculture, Surma Valley Circle, has been granted leave on average pay for two months, with effect from the 5th February 1937.

MR. BENODE BEHARI DAS, B.Ag., Superintendent of Agriculture, on special duty, has been appointed to officiate as Deputy Director of Agriculture, Surma Valley Circle, *vice* MR. SATYENDRA CHANDRA DATTA, granted leave.

Sind

RAO SAHIB K. I. THADANI, M.Sc. (Tex. U. S. A.), M.Ag. (Bom.), F.L.S., F.R.H.S., Botanist and Officer-in-Charge, Agricultural Research Station, Sakrand, has been appointed to be Director of Agriculture, Sind, on probation for one year.

Burma

MR. J. CHARLTON, F.I.C., I.A.S., Director of Agriculture, Burma, has been granted leave on average pay for seven months and thirteen days with effect from the 24th March 1937.

MR. F. D. ODELL, I.A.S., Provincial Marketing Officer, Burma, has been appointed to officiate as Director of Agriculture, Burma, in place of MR. J. CHARLTON, F.I.C., I.A.S., proceeding on leave.

MR. R. WATSON, I.A.S., Deputy Director of Agriculture, Southern Circle, Rangoon, has been appointed to officiate as Provincial Marketing Officer, Burma, in place of MR. F. D. ODELL, I.A.S., transferred.

On return from leave, U BA MAUNG, B.A.S., Class II, has been posted to Rangoon and appointed to hold charge of the duties of Deputy Director of Agriculture, Southern Circle, in place of MR. R. WATSON, I.A.S., transferred.

U KYAW ZAN, A.T.M., Assistant Director of Agriculture, Burma Agricultural Service, Class II, has been promoted to the Burma Agricultural Service, Class I, with effect from the 1st March 1937.

MR. G. PFAFF, M.R.C.V.S., B.V.S., Class I, Research Officer and Principal, Veterinary College, Insein, has been granted leave on average pay for four months and in continuation thereof leave on half average pay for three months and eleven days with effect from the 25th March 1937.

MR. J. BHATTACHARJEE, M.R.C.V.S., B.V.S., Class I, Veterinary Research Officer, has been appointed to officiate as Research Officer and Principal, Veterinary College, Insein, with headquarters at Insein, in place of MR. G. PFAFF, M.R.C.V.S., B.V.S., Class I, proceeding on leave.

Recent Publications of the Imperial Agricultural Bureaux

I. Obtainable from the Imperial Bureau of Soil Science, Rothamsted Experimental Station, Harpenden, Herts

Periodical Abstracts

	s.	d.
List of publications and papers on Soil Science published in the Empire Overseas in—		
1933	1	0
1934	1	0
Soil Research in the British Empire published in 1935	1	0
Lists of Publications relating to Soils and Fertilisers—		
Published monthly, per annum, post free	10	0
Monthly Letters—		
Free to recipients, within the British Empire, of "Publications relating to Soils and Fertilisers". Subscription, outside the Empire, per annum	4	0
Recent Developments in Soil Analysis—		
Quarterly Supplement to the above publications. Separate copies, each	0	6

Occasional Papers

	s.	d.
Technical Communications—		
32. Tea Soils (by H. H. Mann)	2	0
33. Organic Manures (by S. H. Jenkins)	2	0
34. Tropical Soils in relation to Tropical Crops	2	6
Annual Report : For the year 1933-34	0	6
,, 1934-35	0	6
,, 1935-36	0	6
Bibliographies—		
Bibliography on Coffee	2	0
Catalogue of Journals and Periodicals in the Library of Rothamsted Experimental Station	2	0
Special Publication—		
The Katamorphism of Igneous Rocks under Humid Tropical Conditions (by the late Sir J. B. Harrison)	5	0
Bibliography of Soil Science, Fertilizers and General Agronomy, 1931-34	25	0

II. Obtainable from the Imperial Bureau of Animal Health, Veterinary Research Laboratory, New Haw, Weybridge, Surrey

Abstracting Journal

	s.	d.
The Veterinary Bulletin—		
1931. Vol. 1. Quarterly (1st Number, April)	7	6
Annual subscription	20	0
Subsequent volumes. Monthly (1st Number, January)	5	0
Annual subscription (postage paid)	40	0

		s.	d.
	Indexing Publication		
Index Veterinarius.—Four issues a year. First issue, April 1933. Annual Subscription (postage paid). Volumes I to III mimeographed, Volume IV onwards printed		100	0

III. Obtainable from the Imperial Bureau of Animal Nutrition, Rowett Research Institute, Bucksburn, Aberdeen

Journal

Nutrition Abstracts and Reviews. (Issued under the direction of the Imperial Agricultural Bureaux Council, the Medical Research Council and the Reid Library)—

	s.	d.
Subscription per volume of 4 numbers	42	0
Per single number	13	0

Occasional Papers

Technical Communications—

	s.	d.
6. The Composition of Certain African Foods and Feeding Stuffs	1	0
7. Wheat. Pre-eminence as a Cereal Food : Nutritive Value ; Relation to Health and Disease	1	0

Occasional Communications—

	s.	d.
1. The Effect of Climate on the Composition of Pasture Plants	..	

IV. Obtainable from the Imperial Bureau of Plant Genetics (for crops other than Herbage), Plant Breeding Institute, School of Agriculture, Cambridge

Journal

Plant Breeding Abstracts—

	s.	d.
Quarterly. Annual subscription	15	0
Single copy	5	0

Occasional Papers

Indexes to Plant Breeding Abstracts—

	s.	d.
Subject Index to Vols. I to V of Plant Breeding Abstracts	5	0
Subject Index to Vol. VI of Plant Breeding Abstract	2	6

Supplements to Plant Breeding Abstracts—

	s.	d.
Summary of Reports received from Countries exclusive of the British Empire, 1928-31. Supplement I	2	6
Summary of Reports received from Stations in the British Empire, 1932-35. Supplement II	5	0

Technical Communications—

	s.	d.
Vernalization and Phasic Development of Plants, 1935 (Joint Publication of the Imperial Bureaux of Plant Genetics)	10	0
The South American Potatoes and their Breeding Value	3	6

Bibliographical Monographs—

	s.	d.
Breeding Resistant Varieties, 1930-33 (Supplement)	2	0
The Experimental Production of Haploids and Polyploids	5	0

V. OBTAINABLE FROM THE IMPERIAL BUREAU OF PLANT GENETICS (HERBAGE PLANTS), WELSH PLANT BREEDING STATION, AGRICULTURAL BUILDINGS, ALEXANDRA ROAD, ABERYSTWYTH, WALES

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16. The Theoretical Significance of Vernalization, 1934. N. A. Maximov.	2	6
17. Vernalization and Phasic Development of Plants, 1935. (Joint publication of the Imperial Bureaux of Plant Genetics)	10	0

VI. OBTAINABLE FROM THE IMPERIAL BUREAU OF FRUIT PRODUCTION, EAST MALLING RESEARCH STATION, EAST MALLING, KENT

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Horticultural Abstracts—		
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Technical Communications		
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7. Vegetative Propagation of Tropical and Sub-tropical Fruits, 1936. J. St. Clair Feilden and R. J. Garner	2	0
8. Horticultural Aspects of Woolly Aphis Control together with a Survey of the Literature, 1936. R. M. Greenslade	2	6
Occasional Papers		
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4. Recent Work of Tropical and Sub-Tropical Interest	0	6
Other Publications—		
Index to Volumes I-X of the *Journal of Pomology and Horticultural Science*, 1933. Compiled by Bureau, published by the Editors of the *Journal of Pomology and Horticultural Science*. Available from the Bureau	5	0
Old and New Standpoints on Senile Degeneration, 1931. A. P. C. Bijhouwer	0	6
Fruit Growing in the Empire. Standardisation of Horticultural Material with special reference to Rootstocks, 1927. R. G. Hatton. Being unnumbered Empire Marketing Board Publication. (Free).		
Viticultural Research, 1928. D. Akenhead. Being Empire Marketing Board Publication 11	1	0

VII. OBTAINABLE FROM THE IMPERIAL BUREAU OF ANIMAL GENETICS, INSTITUTE OF ANIMAL GENETICS, UNIVERSITY OF EDINBURGH, KING'S BUILDINGS, WEST MAINS ROAD, EDINBURGH

Journal

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Animal Breeding Abstracts (quarterly), commencing April, 1933. Annual subscription	15	0

Occasional Papers

The Technique of Artificial Insemination, 1933	2	6
Bibliography of the Works of J. C. Ewart (free to subscribers of Animal Breeding Abstracts, Vol. 1), 1934	0	6
Animal Breeding in the British Empire. A Survey of Research and Experiment, 1934	2	0

VIII. OBTAINABLE FROM THE IMPERIAL BUREAU OF AGRICULTURAL PARASITOLOGY, INSTITUTE OF AGRICULTURAL PARASITOLOGY, WINCHES FARM DRIVE, HATFIELD ROAD, ST. ALBANS, HERTS

Journal

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Library Edition, bound in cloth	10	6
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17. Vernalization and Phasic Development of Plants, 1935. (Joint publication of the Imperial Bureaux of Plant Genetics)	10	0

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Viticultural Research, 1928. D. Akenhead. Being Empire Marketing Board Publication 11	1	0

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(*i*) The Effects of some Natural Factors on the Second Ecdysis of Nematode Infective Larvae. G. Lappage	4	0
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Report on the Third Imperial Mycological Conference, 1934 . . .	2 0

PLATE XXXII

The All-India Cattle Conference 1937

Agriculture & Live-stock in India

Vol. VII, Part V, September 1937

EDITORIAL

THE ALL-INDIA CATTLE CONFERENCE, 1937.

AN important stage was reached and, we may hope, a new era inaugurated in live-stock improvement work in India, when His Excellency the Viceroy opened the All-India Cattle Conference, which was held in Simla on 25th and 26th May 1937.

Never before has a Conference of Ministers, technical officers, and non-officials been held in this country for the sole purpose of discussing problems connected with live-stock, particularly cattle improvement ; but judging by the good attendance of delegates and their enthusiasm at the meetings despite the inconvenience many of them had to endure during a long and trying journey to the rendezvous, it is not unlikely that provinces may themselves suggest periodical holding of such meetings in future, for the purpose of interchanging views on this subject.

The President of the Conference, the Hon'ble Kunwar Sir Jagdish Prasad, Member in charge of the Department of Education, Health and Lands, asking His Excellency to open the Conference, struck the right note when he said that in a country in which live-stock was held in such regard, it was a sad reflection that abstract veneration should yield so much practical neglect. And listening to the discussions one felt that the improvement of the live-stock industry as a whole, towards which His Excellency had given so much time and thought, was now generally recognized as a subject worthy of deep study by all those who had the welfare of India at heart.

Naturally, in so vast a country as India, with such varying conditions of population and climate, the resolutions on the subjects before the meeting had to be drafted in general terms but one point on which there was complete unanimity was that more funds were required for this work, and that the bulk of them should come from the Central Government, a matter on which the Hon'ble Member who presided was, of course, unable to give any assurance.

A 2

It was, however, pointed out that there were several ways in which a province could, under the new constitution, raise money for such an object as this, as for instance by levying a small cess on animals exported from or imported into a province ; and provided the money so raised was spent on live-stock improvement there did not appear any objection to such a measure.

This discussion also brought out the great necessity for making all possible use in future of all suitably-trained staff, in a province or State, available for live-stock improvement work, and it was particularly recommended that, in the provinces where the veterinary staff was not already provincialized, steps should be taken to define more rigidly the different duties of the Veterinary Department, so that at least part of the staff would be released for disease control and live-stock improvement work directly under the control of the Director of Veterinary Services.

It has often been said that no improvement in India's live-stock can be expected until better provision is made for feeding it. Quite naturally, therefore, a great deal of the discussions was devoted to this subject in which the Conference had the benefit of the advice of several experienced forest officers, who emphasised the point that the Forest Department was intimately concerned in this question of providing more fodder for our animals particularly in the form of grazing.

The point was made, however, that the number of animals that could avail themselves of forest grazing was comparatively small, and that, speaking quantitatively, it was more important to take up the question of improving other grazing and waste lands, which it was hoped to do through the agency of provincial Fodder and Grazing Committees. At the same time, the importance of introducing special fodder crops into the usual rotation was stressed and special emphasis was laid by agricultural experts on the advantages of a leguminous crop like berseem, which in some irrigated areas was reported to have already caught the imagination of the ryot, on account of its value both as a fodder for stock and for improving the fertility of the soil.

Lastly, reference must be made to the decision to establish Cattle Improvement Funds in the provinces, with the double object of providing an outlet for the generosity of those persons who wished to follow His Excellency the Viceroy's example of doing something tangible for the improvement of live-stock and a stable fund on which live-stock officers could draw from time to time to supplement the efforts of the official organizations concerned with live-stock improvement work in the province. It was proposed also to set up provincial Live-stock Improvement Boards or Associations, including a number of non-officials, which might thus be in a position in future to contribute substantially to the development of the live-stock industry in their province.

The Kunbi Cultivator of Gujarat

ORIGINAL ARTICLES

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

IV. THE KUNBI OF GUJARAT (BOMBAY PRESIDENCY)

BY

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GUJARAT is the northern part of the Bombay Presidency and comprises the four British districts of Surat, Broach and Panch Mahals (now one district), Kaira and Ahmedabad, and portions of the Baroda State, whose territory is more or less intermingled with the four British districts.

The soil is alluvial in origin and rich. The soils of Broach and Surat districts are of the heavy black cotton type, Surat soils being heavier. In the Surat tract, there is garden soil of recent origin on the banks of the rivers and this is used for irrigated crops. The soils of the Kaira and Ahmedabad districts are of lighter colour and vary from clay-loam to sandy types. They are well drained and well supplied with underground water which is fully utilized by means of wells for growing tobacco and vegetable crops. The type of farming followed is mixed cereal farming with dairying.

Gujarat depends upon the south-west monsoon for its rains which fall between June and October. The southern part receives forty to sixty inches of rain and is practically free from famine. The central part receives thirty to forty inches of rain, whilst North Gujarat receives twenty to thirty inches of rain and is liable to scarcity. The northern and eastern parts of Gujarat are liable to occasional frost in the cold weather.

The cultivators of Gujarat include many classes, the chief being the Leva Kunbis or Patidars, Kadva Kunbis, Anavils, Bohoras, Kachhias, Rajputs, Kolis, Parsis, Mussalmans, Bhils, and Dublas. Of all these, the Kunbi is common to all districts of Gujarat and is the most important type. He is by far the best cultivator. It is the Kunbi who has made Gujarat so productive as to earn the name of the 'Garden of Western India'. The character of the soil in Kunbi holdings

has been improved by a long course of careful husbandry. Sandy portions near Nadiad, Borsad, and Anand in Kaira district, have been converted by the intelligent ryots into garden land. Similarly, the heavy and rather impervious cotton soils of the **Surat** tract have been made fertile by the hard work of the Kunbi.

The Kunbi is now-a-days a peasant proprietor. Formerly the Kunbis in Kaira and Broach held the village land jointly on *Narva* or *Bhagdari* tenures. Under *Narva* or *Bhagdari* tenures, the village community, *i.e.*, those who shared the village lands, settled hereditarily and jointly for the payment of the revenue assessment to the government. In *Bhagdari* villages revenue was fixed on each field, whereas in the *Narva* tenure, the revenue was fixed in the lump for the village and its division left to the co-sharers. This was possible as the village was originally owned by one person. As the population increased, joint ownership continued for some generations, but eventually due to the great increase in population and to internal strife and jealousy, the *Raiyatwari* tenure has been preferred by the Kunbi.

The Kunbi lives in a group in a village even now, as he is apprehensive of thieves, and so he has often to live several miles away from his holdings. The village is generally built in the centre of the cultivated area. The village has a tank and a well for common use. Near the tank and in front of the village, there is an open space shaded with trees, which is used as a play-ground for the village youths and a resting place for travellers. In this open space, round some aged tree, there is usually a raised platform made of earth and bricks. On this platform the village elders assemble at night for smoking the *hukka* and for talk.

The Kunbi usually lives in a comparatively well-built house, two or three storeys high. The houses, constructed of bricks and tiles, are built in rows of three or four, each group having a common courtyard and a gate. Cattle are tied in the courtyard and, in Southern Gujarat, the ground floor of the house is shared by the cultivator and his cattle. This practice tends to make the dwelling insanitary. The ground floor has two rooms—the inner and the outer. The house has two main doors, one opening into the back-yard, and the other opening into the courtyard. There is also a door between the inner and the outer rooms. In some cases the back-yard is enclosed to provide a kitchen. Houses are not properly lighted and ventilated, particularly when the main doors are closed and were it not for the Kunbi and his family working the whole day in the open, they would suffer in health.

Physically the Kunbi is of medium stature and build. He is fairly hardy and is fond of the toil and hardship associated with farming. He is sober, quiet, industrious, enterprising and frugal, except on special occasions such as marriage and death ceremonies, when he spends rather beyond his means, vying with his

richer brethren. He is very hospitable, frank by nature, simple in his habits and is a good husband and father.

His dress consists of a piece of white cloth wrapped round his head by way of turban, a *bandi* (a coat up to the waist) and a *dhoti* covering his legs. Better classes of Kunbis, particularly the Patidars of Kaira, dress themselves more elaborately by wearing the *angarkha* (long coat) and a turban.

The Kunbi's food consists of coarse rice, *tur-dal*, *bajri* or *jowar* bread, and a few vegetables, usually grown by himself. Though every Kunbi keeps a milch buffalo or two, he cannot afford much ghee (boiled butter), which he takes very sparingly. Even milk is not taken daily. It is stated that he does not give sufficient milk to his children as he is able to sell his milk readily. This is partially true in some cases; in other cases, it is due to the ignorance of the Kunbi as to correct value of milk for growing children. However, he takes plenty of butter-milk, either by using it in preparing porridge of *bajri* or *jowar* flour, or by making it into curry, or drinking it with his meals. The Kunbis of Broach and Surat, as a rule, have taken to tea-drinking twice or thrice a day, but few people in other parts have acquired this habit. Tea is usually boiled black and served with a lot of sugar and some milk.

The Kunbi's amusements are unfortunately few and mainly comprise marriage parties, dramas seasoned by plenty of coarse wit, or attendance at a local fair or at a few friendly parties, where the delicacies of parched grain of *bajri*, *jowar*, or wheat, or *undhia* prepared from the bean, *Dolichos Lablab*, are eaten.

The old village sports or games like *gedi dada* (a game played with a *babul* stick, shaped like a hockey stick, and a soft ball made of rags) and other Indian games played without any equipment are unfortunately becoming things of the past.

Another amusement, that is common in the north is the *garba* dance, usually practised by men and women during the Dasara week. In winter, there is often a vocal music discourse given on the Mahabharata at night by a party of *man-bhats* (*man* being a big copper pot with a narrow mouth used by the party along with musical instruments) and such occasions are well attended by all, young and old, men and women.

Fortunately, the Kunbi is sober and is free from the vice of drink. However, in certain parts the Kunbi has become a confirmed litigant, and is not a cheerful loser.

The profession of agriculture in India is hereditary and a great deal of agricultural knowledge and skill has been developed in the Kunbi. His agricultural skill can be seen in the general high standard of cleanliness of his lands, his careful repeated ploughings, abundant manuring, perfectly straight sowing, utilization of every little space available for crop production, the skill with which

rotation of crops is designed to build up and maintain soil fertility and the long distances over which irrigation water from wells is conveyed across all sorts of obstacles to his cultivated fields. The Kunbi is very fond of his cattle and he likes to tie them near or in his house so that he can feed them at night. Even the bullocks are carefully bathed in hot water in the evening after a heavy day's work.

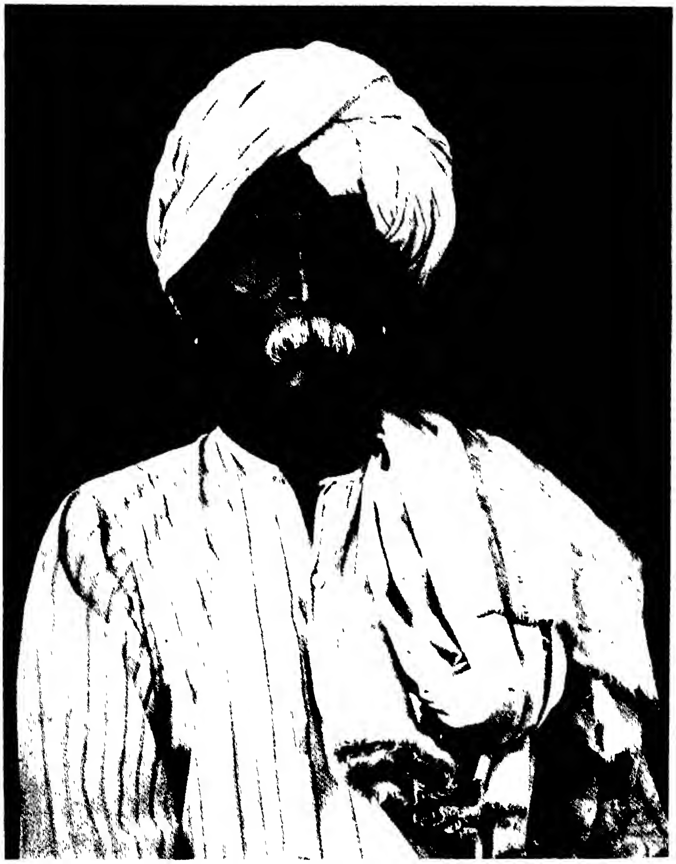
The Kunbi possesses a keen sense of the value of money and this plays an important part in the design of his field operations and in the methods of marketing his crops.

The Kunbi knows his job so well that it is difficult to convince him of the utility of new improvements but, once he is convinced, he is not slow to take to them, even if it is necessary to invest a lot of capital. This trait can be seen in the good and valuable live-stock he keeps, in the quick and almost universal change over from mhots to oil-engines and pumps or to Persian wheels ; in the growing of costly fruit crops, in adopting wider sowing of crops like cotton, in taking to green manuring, and in the use of new artificial manures.

The Kunbis in the Surat tract are well organized and there are many co-operative groups of villages that produce the pure seed of improved varieties of cotton and market their cotton crop jointly.

In the days before the great famine of 1899-1900, the Gujarat Kunbi knew little of calamity. All his current resources were, however, used up to tide over that big disaster. Since then, there have been many bad seasons during the past twenty-five years, which have resulted in many people migrating as labourers to the cotton mills at Ahmedabad, and to distant lands like East and South Africa, to earn their living. This development has been helpful to people at home. The period of high prices during and after the great war helped to improve the condition of the farmer, but much of the profits then gained were spent on houses or in purchasing new lands at very high prices. Like most other cultivators, the Kunbi carries a considerable weight of debt.

In addition, the pressure of population on the land has so much increased that the Kunbi has found it necessary to take to other trades and professions. Yet he prefers agriculture and it is mostly the Kunbi who has ventured to take up waste lands in Gujarat for large-scale cotton-growing and, in many cases, has migrated to Central India for agricultural purposes. Though he has paid high prices for such lands he has almost invariably made a success of his agriculture wherever he has settled on account of his inborn skill and industry.



The Lingayat Cultivator

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

V. THE LINGAYAT OF THE KARNATAK (SOUTHERN MARATHA COUNTRY, BOMBAY PRESIDENCY)

BY

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THE Karnatak forms the southern portion of the Bombay Presidency and comprises the four districts of Dharwar, Bijapur, Belgaum and North Kanara. Agriculturally it may be divided into two distinct tracts, *viz.*, the 'Malnad' and the 'Baila-Seemi'. The first is the western hilly tract with a large forest area and limited cultivation. The second is the extensive plain covering the central and eastern portion of the Karnatak. The latter is also known as the 'Yeri-nad' from the colour of its soil which is black.

The Malnad is comparatively a small tract. It has a heavy rainfall, ranging from 40 to 160 inches. Rice forms the main crop and is grown in terraced fields in the valleys. The Baila-Seemi is by far the bigger and more important area. It extends over the whole of the Bijapur district and over two-thirds of Dharwar and Belgaum districts, covering an area of 11,800 square miles with a cultivated area of five-and-a-half million acres. It is favoured by both monsoons and has a total rainfall ranging from twenty to forty inches. Its wet season thus extends over a period of eight months in the year. The rainfall is greater where this tract meets the Malnad but, towards the east, it decreases and the crops are often subject to scarcity. The long wet season permits a wide range of *kharif* (early), *rabi* (late) and two-season crops. It is noted for its medium-stapled 'Kumta' and 'Upland' cottons.

The Karnatak cultivator belongs to a community called the Lingayat which forms the bulk of the population. As a distinctive feature of his caste, the Lingayat wears constantly on his person a 'Linga' which is a religious symbol of the God Shiva. He is a strict vegetarian and a total abstainer from intoxicating drinks. For generations, farming has been his only profession, handed on by father to son. By tradition, training and religion, the Lingayat farmer is a son of the soil and a lover of his cattle. He differs both in body and mind from his cultivator brother of the Maharashtra. He is more Dravidian and is bigger-boned and deeper brown in complexion.

His dress is very simple, consisting of a turban, a shirt, a *dhoti* and shoes (*chappals*). The turban is typical of the Karnatak and is worn by the rich and poor of all communities. It is a plain square piece of cloth, with or without a border, stretched diagonally and wrapped round the head. It is usually white, except on ceremonial occasions, when coloured turbans, wholly or partly of silk, are used. The Karnatak farmer when out of doors is never without his turban. In addition, he occasionally carries a piece of cloth on his shoulder over the shirt.

His diet is very simple. It consists mainly of *jowar* bread, *nucchu* (broken and boiled *jowar* grain), boiled pulses, a small quantity of any vegetable that may be available and some rice if he can afford it. His holiday dish is either *huggi* (whole wheat grain boiled with some *gul*) or *malidi* (boiled wheat, dried, pounded and mixed with some *gul*). The latter is preferred for journeys and in camps. A boiled and sweetened macaroni-like wheat preparation is also very much liked and is used on ceremonial occasions. Onion, garlic and chillies are his main spices. He generally maintains a she-buffalo and uses the curds and butter-milk for himself and his family. He gives a small quantity of milk to his children but chiefly makes butter and sells it. Ghee is a luxury which he enjoys in small quantities only on holidays. He daily uses some safflower oil in place of ghee with his spices. He seldom has any fruit in his diet, but eats a few mangoes in season. His children in addition eat plantains. Spiced and salted pickles of green mangoes, tamarind, or cucurbits generally serve as accompaniments to his bread. He has no sweet preserves. He is content with whatever he grows and can obtain locally. As his religion enjoins on him, he eats to live and there is no luxury about his diet. It may be noted here that his food is rich in carbohydrates and proteins but lacking in fat and vitamins.

The Karnatak cultivator's daily routine is as follows. He gets up at 5 A.M., feeds and grooms his bullocks, brings water for his family, takes a light breakfast of the previous day's bread and then moves out to his work with his bullocks and necessary implements. He works in the fields till mid-day. Meanwhile, his wife sweeps the house, cleans the byre, grinds corn and prepares fresh food and takes it to her husband in the field. The farmer then has his lunch and he and his bullocks have a couple of hours' rest. He resumes work at 2 P.M and continues till about 5 P.M. when he takes a third meal of *jowar* bread and boiled pulses and returns home with a head-load of green fodder when available. His wife, who also works on the farm, accompanies him. On arrival home, he again grooms and feeds his cattle and takes some rest. This is the only time when he can meet his neighbours and discuss matters of personal and local interest. He has his supper at 8 P.M. He then gives some fodder to his cattle and goes to bed. Monday is an off-day for bullocks and is the regular washing day when the house is generally cleaned and clothes and cattle are washed. He also invites the priest to visit him on these days, feeds him and receives his blessings.

In the sowing and harvesting seasons, he is very busy with his farm work and finds little time to do anything else. In other seasons he has light work but has not taken to any by-industry worth mentioning.

The Karnatak farmer has very few organised games to play. His children mostly play marbles, 'tip-cat', and similar games as they have no costly accessories. There are no regular playgrounds and children and young boys play in the village streets or on grazing grounds while tending cattle. Young men are fond of wrestling and gymnastics. Most of the villages have common gymnasiums and the youths go and practise there for an hour or two in the evening. Men past middle-age take no active part in any game but are very fond of witnessing wrestling matches. The farmer's amusements are equally simple and are largely connected with his bullocks. He has some special holidays in the year when he decorates his bullocks and takes them out in procession through the village and holds competitive tests of their physical strength in drawing heavy loads. Religious and cattle fairs are very common after the harvesting season and the farmer takes great pleasure in visiting them with his family. Wrestling matches are invariably arranged at these fairs and these attract large crowds of Lingayat cultivators. The farmer does three things at these fairs. He worships his God, buys his requirements and enjoys shows like wrestling matches, the singing of country ballads and the performance of village dramas. Another occasion of great interest to him is the visit of his *swami* or religious *guru* when his enthusiasm is unbounded.

The Lingayat farmer has no real vices. His only habits are to smoke tobacco in green leaves and to chew it with *pan*. Tea drinking is a recent introduction and is slowly increasing in the villages. The farmer has, however, many drawbacks. He spends much during marriage occasions and very often runs into debt. He is illiterate and has caste prejudices. He has no liking for any other occupation. His religion does not allow him to take to poultry and sheep-breeding. He does not even touch eggs and washes his hands if he does so. His wife interests herself in dairying and earns some money by selling butter. For repairs to his implements, he depends on the village carpenter and smith. He is a poor tradesman and it is his wife that carries out the weekly shopping. She buys even his *pan* and tobacco. He is easily excitable when differences arise regarding his honour or his land and is a hard litigant in such matters. Such disputes may easily result in his financial ruin or in physical injury. His knowledge does not extend beyond his daily routine.

The Karnatak cultivator grows mostly dry crops. By age-long experience he knows when, how, and what to do. He is diligent and hard-working but not progressive. In most cases he owns a small piece of land and takes on lease other portions to make a good unit for a pair of bullocks. Farming being his only profession, he competes for the possession of land and often pays heavy rents.

Depending upon rainfall as he does, he suffers in bad years and gets into debt. Heavy expenditure on marriages and litigation causes additional debts and interest charges to accumulate. He is very fond of his lands and does notlike to part with even a portion of them to clear off his debts. He thus allows the interest to accumulate until the whole of his land is at stake. He knows the art of farming but gambles when taking lands on lease. The great depression during the last few years has put a check to this gambling and he is now attempting to cultivate other's lands mostly on the share-system. He is by nature an honest and industrious worker and, if wisely helped and guided, should have a better future. A few farmers are met with here and there who have not only not incurred any debt but on the contrary have improved their position. These are mostly men who have not tried to gamble and who have taken to the improvements introduced by the Agricultural Department.

THE SEARCH FOR NEW GENES*

BY

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THE GENES

IT has long been known that plants, like animals, are composed of minute cells and that in the middle of each cell is a denser body, termed the nucleus, in which, during cell division (the process by which the plant or animal grows or replaces damaged tissue), are found dark-staining, rod-like bodies termed 'chromosomes'. It has been demonstrated that these chromosomes contain a large number of living particles called 'genes' which are arranged in linear order along the length of the chromosome. The hereditary elements or genes are the determiners in the development of hereditary characters and are transmitted from one generation to another by means of chromosomes in the germ cells. All heritable characters whether structural or functional are due to the actions or reactions of the genes with the environment. The genes may, therefore, be termed the units of inheritance.

Genes are inherited in groups, that is to say, certain genes are found to pass together from one generation to the next. It has been observed that the number of groups of genes corresponds with the number of chromosomes in the germ-cells of a particular organism. Thus, for example, the pomace fly with four chromosomes in its germ-cells has four groups of genes, maize with ten chromosomes has ten groups. The genes which are inherited together are said to be linked. Sometimes, however, the linkage breaks down and as a result of crossing over (*i.e.*, exchange of pieces of chromosomes) one or more genes may be transferred from one group to another.

The genes are extraordinarily stable and normally pass from generation to generation without change. Occasionally, however, sudden changes or mutations occur. The mutated gene retains the property of stability and goes onward as before in its new condition. The exact nature, action and physiology of the genes are still unsolved, but they are believed to be complex protein molecules.

The number of genes present in each organism is very large. It has been estimated that the number of genes vital to the normal life of the pomace fly,

*This is the seventh of a series of popular articles for practical farmers on various agricultural subjects of general interest.

Drosophila melanogaster, is not less than 14,380. In plants, the inheritance of a large number of genes has been studied. This is especially true in the case of maize where the inheritance of over 350 genes has been investigated.

THE IMPORTANCE OF NEW GENES IN PLANT BREEDING

The scientific breeding of cultivated plants has become indispensable in the agriculture of progressive countries, in order to meet the changing and increasing demands for food and raw materials. The re-discovery of Mendel's laws of heredity in 1900 gave a stimulus to plant breeding, and numerous new forms of plants have been evolved by selection and hybridization. After a time, however, it became apparent that in many cases the limit of improvement by this means had been reached. The genes present in the existing varieties "had all been utilised and all the most desirable combinations had already been attained though in many cases the ideal had not been fulfilled" [Hurst, 1936]. It became necessary, therefore, to discover or introduce new genes and to devise new ways of combining them with the old genes.

It has been found that, in the case of many crop-plants, wild or little-known allied species or varieties exist and in several cases these are resistant or immune to the devastating diseases which attack their cultivated relatives or they possess some other attributes which render them desirable material for breeding. If the genes conditioning the disease-resistance and other desirable attributes of the wild or semi-wild species could be incorporated in the commercially cultivated varieties of crop-plants by hybridization, many of the most pressing problems of crop production would be solved. To facilitate such work, modern plant breeders are constantly on the search for new genes for use in plant breeding.

THE SEARCH FOR NEW GENES

To achieve this object, the agricultural departments of several countries, notably Russia, U. S. A. and Germany, have organized expeditions to different parts of the world to make collections, in their probable places of origin, of as many varieties of crop plants and their wild allies, as possible.

The Russians under the able leadership of Dr. Vavilov, Director of the Institute of Plant Industry, Leningrad, have during the last decade carried out this search for new genes on an extensive scale and in the most systematic way not only in their own country but in a great part of the Old and New Worlds. They sent out expeditions to various parts of Russia, Asia Minor, Caucasus, Transcaucasia, Turkistan and Siberia, as well as the outlying areas of Sin Kiang and Mongolia, North-Western India, Afghanistan, Persia and Abyssinia, while in the New World in 1925 and 1926 they sent expeditions to Mexico, Guatemala and Columbia and in 1927 and 1928 to Peru, Bolivia and Chile. Many hundreds of new varieties, both wild and cultivated, have been introduced into Russia and these contain many thousands of new and valuable genes.

The United States Department of Agriculture maintain a Bureau of Plant Introduction which is continually introducing into the United States useful wild and cultivated plants from all over the world. From time to time expeditions are sent to collect special crop plants and their wild allies, to the probable centres of origin in the various parts of the world.

The Germans under the leadership of Schick, in 1931-32, also have made important collections of potatoes from Latin America for the Kaiser Wilhelm Institute at Müncheberg.

The study of the probable places of origin of cultivated plants discloses the striking fact that most of them have come from certain restricted zones in the Old and the New Worlds. Among the most important of these areas are the regions between the foot of the Western Himalaya and the Hindu Kush, certain parts of China, Asia Minor, and Abyssinia, in the Old World, and Central America (including Southern Mexico) and Peru, Bolivia and Chile, in the New World. In their respective centres of origin, cultivated plants display a wealth of varietal diversity which is not to be found elsewhere. A characteristic feature is that these primary centres frequently include a large number of genetically dominant characters. As we proceed outwards towards the periphery of the region of maximum diversity, forms with recessive characters become more evident.

The researches of Vavilov and his co-workers have shown that the region of north-western India and south-eastern Afghanistan is the place of origin of the soft and club wheats and also of many other field and garden crops, *e.g.*, rye, pea, lentil, beans, flax, carrot, etc. The 28-chromosome group of wheats has had an entirely separate centre of origin, in Abyssinia. The eastern Asiatic region has probably seen the origin of rice, soybean, and some of the millets. In the New World the rather restricted territory of Central America (including Southern Mexico) is the home of such plants as maize, teosinte, the common bean, annual pepper, agave, anona, sapota, papaya, etc. Tobacco probably originated in South America. The potato plant probably had more than one centre of origin. While the island of Chile and the neighbouring islands off the coast of Chile are probably the centre from which the common cultivated potato originated, many cultivated and wild species have originated in the Peru-Bolivian tableland.

It is a striking fact that, until comparatively modern times, the Old World and the New World had few cultivated plants in common. The great majority of the cultivated plants of the two hemispheres are represented by entirely different genera and before the days of Columbus many cereal and leguminous crops cultivated in the Old World were unknown in America, while American crop-plants such as the potato, maize, etc., had not been introduced to the Old World.

It will be apparent that many of the important centres of origin are associated with the tropics or sub-tropics and the presence of mountains. This may

perhaps be connected with the fact that in such regions an optimum of moisture, heat, light and substratum have afforded favourable conditions for the origin and accumulation of varietal diversity. Mountainous areas tend to act as isolators and thus may have played a part in the differentiation and divergence of species and varieties. An interesting speculation that cosmic rays might be responsible for the greater diversity and density of species near the mountain tops has been advanced by Dixon, Hurst and, more recently, by Hamshaw Thomas. The cosmic rays are particles of very great energy which are constantly reaching the earth in very great numbers and closely resemble the X-rays in their properties and effects. As X-rays are at present the most efficient agents known for the artificial production of mutations, it appears possible that cosmic radiations may have been a factor in the production of varieties by direct action on the germ-plasm. It is interesting to note that the centres of origin of cultivated plants are also often near the centres of ancient civilizations.

With the acceptance of the concept of primary centres of origin of cultivated plants, the expeditions referred to previously have naturally been directed to the probable centres of origin of the plants of which it was desired to obtain further material. As a result of these expeditions a vast wealth of material has been collected which has entirely altered our views regarding the varietal diversity of many important crops. For instance, prior to the Russian expedition to Abyssinia in 1927, the general belief was that the 42-chromosome wheats possessed the greatest degree of variation. This expedition, however, revealed such a number of botanical varieties and varying characters in the 28-chromosome wheats that the former view has had to be considerably modified.

The material collected by such expeditions may be useful in two ways : (*1*) the new species or varieties which have been discovered may prove directly useful for cultivation in the country to which they are introduced, (*2*) they may provide valuable material for breeding. Referring to (*1*), it is well to recall that many of the principal crops entering trade have been introduced into the part where they are now extensively grown from some other region of the world. Thus, for instance, rubber, which is mainly grown in the Far East, originally came from the Amazon region of South America. Sugarcane, which is perhaps the dominant crop of the West Indies, came from the East. Cinchona, a native of South America, is largely cultivated in the Dutch East Indies. Many other examples can be given. It is clear from these that the possibilities of plant introduction and acclimatization are probably not yet fully exploited. Certain crops which are much valued in Peru, Chile and Brazil are yet unappreciated elsewhere, *e.g.* ulluco (*Ullucus tuberosus* Lozano), oca (*Oxalis tuberosus* Molina), etc.

The greatest value of the new material, however, is as a source of material for crop improvement. To give a single instance, potato breeding has been revolutionised by the discovery in Central and South America of a large number

of cultivated species (hitherto unknown and totally distinct from the common cultivated species, *Solanum tuberosum* L.) and wild species. Several of these species possess valuable characters not present in the genetic constitution of *S. tuberosum*. Thus *S. demissum* Lindl., *S. Antipoviczii* Buk. and *S. neoantipoviczii* Buk. are immune to the dreaded late blight caused by *Phytophthora infestans* (Mont.) de Bary. *S. acaule* Bitt., *S. demissum*, *S. ajanhuiri* Juz. et Buk. and a few others are frost-resistant. *S. Rybinii* Juz. et Buk. is resistant to virus diseases and is also free from dormancy of tubers. *S. phureja* Juz. et Buk. has an unusually high protein content and *S. andigenum* Juz. et Buk. contains genes for high yield, and a certain amount of resistance to disease. Potato breeders are busy attempting to transfer the genes determining these attributes to the common commercial varieties.

Advances in the technique of hybridization of widely different species and even genera, and the discovery that sterile hybrids may be rendered fertile by the doubling of the chromosome sets, have made it possible to bring together gene-complexes in desirable combinations. In Java and India, the practical value of the distant crosses between sugarcane (*Saccharum officinarum* L.) and the wild sugarcane (*S. spontaneum* L.) and between sugarcane and sorghum is well known. Another remarkable example is the cross between wheat and a perennial grass (*Agropyrum*) which has been achieved in Russia and holds out prospects of obtaining a perennial wheat with great hardiness, capable of being cultivated in regions where ordinary wheat cannot be grown.

Other methods of increasing genetic variability

Mutations and changes in the genetic constitution of plants have been induced by means of X-rays, chemicals, changes of temperature, centrifuging, grafting, mutilation, etc. Most of the mutations produced artificially have, like those produced in nature, proved to be retrogressive and of little practical value. The importance of haploids and polyploids in plant breeding, however, has been realized and methods for promoting their production are being devised.

Conclusion

Modern plant-breeders are building up and maintaining extensive collections of cultivated crops and of wild-growing species which may be of possible value for plant breeding. There are, however, still many areas in the world the plant resources of which are as yet untapped. China, one of the primary centres of origin of cultivated plants, offers wide opportunities to the plant explorer. The vast natural resources of the Amazon basin, owing to difficulties of penetration, have hardly begun to be exploited. There remains also the prospect of entirely new basic species, hitherto uncultivated, being brought into use by man.

C

The plant breeder must reduce the hazard of crop losses through pests and diseases by breeding resistant or immune varieties. The new conditions of modern life allow diseases to become serious and to spread rapidly. New forms of diseases and new needs are constantly arising and new varieties of crop plants are in constant demand. The search for new genes therefore goes on.

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FIG. 1. Early stages of gully erosion on grazing land in Jhelum district. The high bank behind shows that cultivated fields are under a good regime of *watt bandi*, and yield very little run off. Flood damage here arises entirely from grazed slopes.

FIG. 2. Abandoned fields near Duman, Jhelum district, in the last stages of destructive gullying. The gullies here have cut back from the adjoining torrent bed through grazing slopes, eventually undermining the previous system of *watt bandi* and terraced fields.

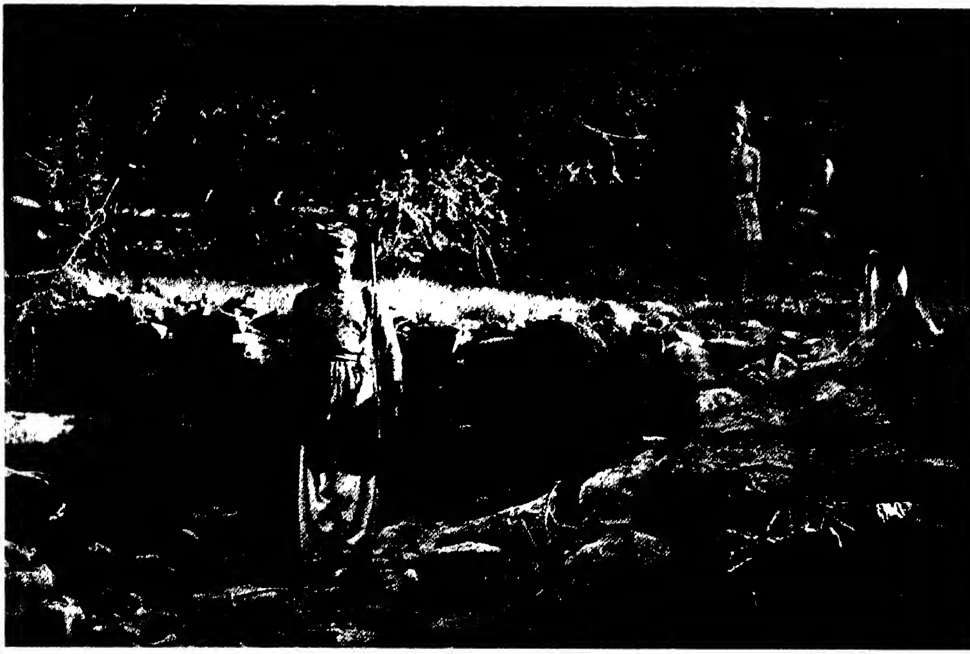

FIG. 1. 'Gully-plugging' with small stone bunds catches soil and stabilises run-off This bund was built in 1908 in Kalachitta Forest Reserve Attock district, and still maintains a good patch of wild oat grass in the bed of the *nala*.

FIG. 2. Country south-east of Rawalpindi left literally as bare as a desert and eroding fast—result of persistent goat browsing, *vide* flock of goats on left. The run-off from such is the immediate cause of floods which destroy fields and submerge them under dumps

THE FOOT-HILLS GRAZING PROBLEM IN INDIA*

BY

R. M. GORRIE, D.Sc., I.F.S.

INDIA contains such a variety of climates that it is difficult to convey a general picture of grazing conditions for the whole of it. The climate varies from real desert with a 3-inch rainfall to Cherapunji with its famous 400 inches. This paper is concerned with the drier half of the country, in which the rainy seasons are separated by sufficiently long periods of drought to make fodder supply a serious problem. It, therefore, applies to the Punjab and North-West Frontier, Sind, the United Provinces, Central Provinces, Bihar, Orissa, the drier parts of Bombay and Madras, and a multitude of Indian states which are included within this vast tract of country [Gorrie, 1933]. Whether the rainfall is 80 in. or 8 in., it occurs in a short series of monsoon storms, after which the country is parched for many months, mitigated to a varying extent by gentler winter rains, which are at best unreliable. Winter frost reduces the variety of vegetation in the north-west, and increases the difficulty of keeping animals in condition ; thus in spite of a more or less regular monsoon the nett result in the Punjab plains and foothills is a climate strangely akin to that of the 'South-Western Desert' of U. S. A. and the interior range lands of Australia.

Almost every kind of live-stock competes for a living—milk cattle, plough cattle, water buffaloes also used for milk and plough, sheep, goats, camels, donkeys, mules and pack bullocks, *plus* huge migratory flocks of sheep and goats which descend from the high hills every autumn to the adjoining plains, like locusts in their numbers and powers for sheer destruction. The better-known breeds of Indian cattle such as Hissar and Danni are bred only in areas where there is practically no common grazing ground left, or are kept as pampered pets stall-fed by the household to which they belong. Where the people have been forced to rely entirely upon stall-feeding they have naturally concentrated upon fewer and better animals. The awful deterioration in the type of cattle wherever common grazing still persists as the usual practice is a most striking and consistent feature of Indian animal husbandry. This deterioration is seen at its miserable worst in all districts containing large areas of wild land too steep or too poor for cultivation, and, therefore, includes the whole of the Western Himalayas and the many ranges of lower hills further south. The incidence of livestock to ploughland varies from 0·62 head per acre in Ludhiana, a typical non-forest district, to 0·98 head per acre in Rawalpindi, a forest district. As the

* This paper appeared in the June 1937 issue of Herbage Reviews published by the Imperial Agricultural Bureau.—ED.

farm community alters towards the grazier type, the daily milk output per cow drops from somewhere about sixteen or twenty lbs. of milk to less than a $\frac{1}{4}$ lb. This is no exaggeration ; the average village cow in the foothills seldom yields more than a *chittank*, which is two ounces.

Apart from grazing, the food resources for animals comprise (*a*) straw and stubble from crops such as rice, wheat, and sugarcane ; (*b*) leguminous and other fodder crops ; (*c*) cut grass ; and (*d*) tree loppings. Rice straw is the mainstay in many districts but is not in itself a maintenance ration. Lander and Dharmani [1931] place the value of Kangra rice straw as well below this standard, which is the minimum digestible protein needed to keep a cow fit when not working ; it would not provide for a plough-bullock at work nor for a good milker. Wheat straw is somewhat better in food value, but the amount available is sufficient only for a short time after each harvest. The chief fodder crops are *juar* (*Sorghum durra*) and in irrigated tracts berseem and *shaftal*, both forms of clover, and lucern ; again the amount of these fodder crops is in inverse proportion to the amount of wild grazing land available, and the poorer districts have such a hard struggle to find enough land for their own food crops that they cannot grow any fodder. This is a point which many animal husbandry enthusiasts have failed to grasp.

The value of cut grass is also pretty low in the foothill areas, partly owing to the natural poorness of the grass crop from land which is heavily over-grazed for at least nine months in the year, and partly owing to the method of harvesting the grass. At the time when hay ought to be made in the months immediately following the monsoon, the cultivator is busy with his autumn ploughing, so the cutting of grass is inevitably delayed until only the dry bones of the grass crop are left. It is not possible to alter the agricultural calendar, so improvement appears to lie along the lines of grass cultivation by contour ridging and, by any other means which will keep the grass longer green. The possibilities for the improvement of wild grasslands along such lines are tremendous, but so far are practically untouched. Possibly the best samples of ordinary foothills grass crops are harvested by the Military Grass Farms from areas which they hold or lease, and the analyses of these show [Lander and Dharmani, 1937] that very few of them constitute a maintenance ration, though these are above the village average in so far as closure is enforced for the whole year instead of only the monsoon months.

A peculiar feature of Indian animal husbandry is the dependence of many localities upon tree loppings for fodder. In the oak zone of the lower hills at 4,000 to 6,000 feet *Quercus incana* and *dilatata*, in the higher hills *Quercus semecarpifolia*, and in the more arid hills *Quercus ilex*, are all very heavily lopped so heavily in fact that one or other is being completely driven out and destroyed over large tracts, *e.g.*, *Quercus dilatata* in the Murree hills, *Q. incana* in Kangra,

The same thing applies in a still lower zone where *Olea cuspidata*, the wild olive, still persists in face of very heavy misuse in the limestone and sandstone of the Jhelum Salt Range and other arid hilly tracts below 3,000 feet altitude. The combination of persistent grazing, browsing, and lopping under an exceedingly arid climate is more than even this hardy species can stand, and it is disappearing from a landscape already devastated by erosion. Many similar instances could be quoted for the less arid tracts in the other provinces enumerated above; the process of desiccation, disforestation, and inevitable erosion can be seen by any intelligent observer on any train journey across India from north to south or east to west.

The human population of India is increasing at the rate of about three millions per annum. Much of this increase is occurring in the tracts where nature in the first place provided easy conditions for human settlement, *i.e.*, a not too heavy rainfall for the ordinary farm crops, and natural grasslands in which cattle thrive and remain healthy. Within the heavy rainfall areas further east, the re-growth of dense tropical jungle and conditions inimical for live-stock have discouraged dense settlement. Therefore, much of the weight of this increasing population is falling upon the 'tension belt' where grassland can only persist under reasonable treatment, and if once destroyed, cannot reinstate itself as easily as it can under a slightly heavier or better-distributed rainfall. Hence, over very large tracts of country, natural grasslands have already disappeared and village live-stock are dependent upon bush and tree growth for their day to day existence. In most other countries live-stock is maintained on a ration of grass, and the bush growth which occurs in the grazing grounds is looked upon as a natural reserve which should be used only in times of acute scarcity; in much of India the last vestiges of shrub growth already form the ordinary daily ration for the village herd. The amount of erosion caused directly through this state of affairs has to be seen to be believed. Figures of torrent intensity for various conditions of the plant cover in arid Punjab foothills have been published [Gorrie, 1936] giving the approximate maximum run-off in terms of cubic feet per second per square mile. The Pabbi range is a very low ridge of rapidly eroding Siwalik sandstone and shale, part of which (*i*) has been under a regime of afforestation and counter-erosion work for some years; such land though not fully covered even when fully protected yields a run-off of less than 100 cusecs maximum, enables cultivation to be done close to the streams which drain from it and yields a revenue of a rupee per acre for grass cutting. (*ii*) Similar land under a passive regime of protection against grazing but with no active afforestation or gully-plugging work yields a maximum of 600 cusecs. (*iii*) Similar land under grazing, partially but ineffectively controlled, yields 1,000 cusecs. Its revenue is an anna per acre for grazing (1/16th of a rupee), and no cultivation is possible within a very wide strip of sandy waste which borders the resulting torrent bed in the flat lands below. (*iv*) In the fourth case, where persistent

cattle and buffalo grazing has destroyed the cover and reduced the area to slopes of shifting sand anchored only by the relics of scrub jungle, the run-off rises to the alarming figure of 1,600 cusecs. These figures are for small individual catchments of two to ten square miles area, and this last figure, therefore, represents a tremendously high percentage of run-off, in the neighbourhood of ninety per cent of the rainfall for the typical sudden torrential downpour falling on ground previously parched by drought.

The effect of this state of affairs upon the question of water supply is only beginning to be realised, although in a country where water is proverbially worth its weight in gold, one might have expected a more intelligent attitude towards water conservation. In spite of the warnings given by a series of forest officers since the activities of Baden Powell in 1870, the civil authorities, with one or two brilliant exceptions, have failed entirely to grasp the situation, and are only now having it forced upon their notice through the recurring failure of the Punjab canal systems to produce sufficient water for cold weather irrigation.

There has been a popular impression in the Punjab that the water resources of the province were being husbanded by the Forest Department, but this is being gradually removed with the realisation that this department holds only a small percentage of the total foothill catchments, and even in these its hands are absolutely tied by legally binding but ridiculously generous forest settlements under which effective control of grazing is more or less impossible. The rest, a very much greater area, lies in village grazing lands and in a number of native states where over-grazing, and other misuse of land such as bad cultivation methods, are even worse than in the Punjab foothill districts. Today the fringe of the problem has hardly been touched, in spite of very strong recommendations by the Royal Commission on Agriculture for India of 1928. Animal husbandry in its widest sense, (including the control of grazing, the substitution of grass cutting and stall feeding, and the improvement of grasslands), as an obvious preliminary to the improvement of the local live-stock has not been tackled because it is 'nobody's child'. The Agriculture Department is mainly concerned with the breeding of improved strains of crop plants and the control of pests in the wealthier agricultural areas ; its staff seldom penetrates to the 'junglier' areas which are most in need of help. The Veterinary Department is anxious to establish improved breeds of all sorts and start sheep farms in a country already overburdened with live-stock. The Forest Department is on a commercial basis in spite of being in nominal charge of large tracts which can never produce anything more than fodder, and intensive work is, therefore, confined to that small area of forest which produces revenue from timber. The Revenue Department, which ought to have the interests of the zamindar farmer at heart, is too anxious about its current revenue to be far-sighted in its planning and control of land uses. There is great need for some new trend in district government which can combine the various technical specialists' help in executing a sound policy of land

use with fodder production as one of its main objects. The change from grazing to grass-cutting and stall feeding requires a drastic revision of the whole economic life of the grazing communities, and can, therefore, only be brought about gradually, but for the welfare of the country as a whole, this change is absolutely essential.

The Punjab Government has already taken steps in this direction by detailing three forest officers to different districts on special duty to obtain closures to grazing through the co-operation and consent of the villagers. In Hoshiarpur in two years some 70,000 acres have been closed in this way, and more recent work in Ambala, Gurgaon, Jhelum, and Gujrat districts is also beginning to bear excellent results. These officers are each working in areas where erosion has already reached an alarming stage, and their work in the villages has been towards a combination of rotational grazing closures, and the reservation of hay-fields, with erosion control, torrent reclamation, stream training, and afforestation projects on a scale suitable to meet the needs of each village or group of villages. Constructive work can only be done on a self-help basis of free labour because government cannot afford to undertake any.

The two main heads for their activities are (*i*) to develop fodder resources for local live-stock, and (*ii*) to improve the standard of cultivation in any way which will tend to conserve soil and reduce run-off. Under the first of these two heads the common lines of attack are :—

(*a*) Rotational closures of grazing lands belonging either to individuals, village communities, or government. Much government land is so heavily burdened with rights as to be uncontrollable except by agreement.

(*b*) Partition of *shamilat*, by allocating the common grazing land to individuals to cultivate, or conserve for their own animals ; this has been extraordinarily successful where there is a real scarcity of cultivated land, and has produced some of the finest examples of soil conservation work by individuals, *e.g.*, Mr. F. L. Brayne's work in the Jhelum and Gurgaon districts of ten to fifteen years ago.

(*c*) *Panchayat* or village committee management ; in certain parts the delegation of authority to these committees has been most beneficial.

(*d*) Intensive improvement of natural grasslands, including 'gully-plugging' to stop active erosion, and the application of the principle of *watt bandi* or contour ridging, so far applied only to farm crops, to the more gently sloping grasslands.

(*e*) Develop the tree fodder supply by distributing transplants of suitable tree species and by controlling the very heavy lopping of the oaks, which incidentally is confined to government forest. When these

trees occur in private lands they are carefully lopped on a reasonable rotation.

(*f*) Develop the use of green fodder crops and silage. In the poorer parts land cannot be spared for any crop that does not produce human food. Silage is being taught extensively by the Agriculture Department but is nowhere popular yet.

(*g*) Research on the correct grazing incidence for local types of bush and grass ; given stall feeding for the two hottest and driest months in the year, and closure during the monsoon growing period, this incidence could actually be fairly high for the remaining months without causing excessive denudation.

(*h*) Restrict immigrants' and non-right-holders' live-stock ;—a thorny problem where itinerant flocks are welcomed for the manure they bring to the fields they squat in, and where some of the immigrant communities have already forestalled us by acquiring nominal holdings of land so as to rank as right-holders.

(*i*) Reduction of local herds by encouraging castration of scrub bulls, and by propaganda and demonstration of 'fewer and better cattle'. The change to grass cutting will in itself be helpful because nobody will cut grass for animals which will give no return in work or milk.

This last item, the reduction of surplus animals, should really be placed first, because if it is omitted the rest of the work will be largely thrown away. Where progress depends upon persuasion, however, so drastic a suggestion may do more harm than good by antagonising the whole community.

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VERMINOUS PNEUMONIA IN DOMESTIC ANIMALS—ITS CONTROL AND TREATMENT*

BY

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THE invasion of the lungs, trachea, bronchi and bronchioles, of animals by roundworms is known by a variety of technical and common names such as pulmonary strongylosis, verminous bronchitis or pneumonia, 'husk' or 'hoose' or simply lungworms. Verminous pneumonia in domesticated animals is a most serious disease for which no reliable method of treatment or prevention is known. Though the effects of lungworms on their hosts are not always sufficiently spectacular to attract immediate attention, they are, however, responsible for enormous losses resulting from poor health and decreased resistance. Innumerable epizootics of lungworms have been described in literature. In Morocco and parts of Algeria losses of half of the herds during some years have been described. Similar reports have come from the river Plata, from the Argentine and Uruguay where during certain years three-fourths of the herds involved were destroyed by these parasites. Certain districts of Bessarabia, Rumania and Hungary have similar losses on record. The disease has always been very prevalent in Northern Germany and Holland on account of the proximity of the pastures to water and tidal waves. From several areas of the U.S.S.R. similar losses have been reported.

Besides, the larvae of many roundworms which inhabit the pulmonary tissue only temporarily during their multifarious wanderings in the bodies of their hosts and then leave quickly for their seat of predilection, there are several roundworms which parasitise the lungs, pulmonary connective tissue, bronchi, bronchioles and trachea in their adult stage.

The most important and widely studied genus is *Dictyocaulus* containing three species of economic importance, *viz* :—*D. filaria* (Rud., 1809; Railliet and Henry, 1907), *D. viviparus* (Bloch, 1782; R. & H., 1907) and *D. arnfieldi* (Cobb., 1884; R. & H., 1907).

DICTYOCAULUS FILARIA

This large lungworm of sheep, goat rarely and camel, is a slender, whitish, thin-walled worm with a dark line extending throughout its length which varies

*This is the eighth of a series of popular articles for practical farmers on various animal husbandry subjects of general interest.

from 2·5 in. to 3 in. in the male and 3 in. to 4 in. in the female. The parasite is of world-wide occurrence and is considered to be a serious source of loss.

Life-history

The eggs are embryonated when laid in the air-passages. They may hatch in the lungs but are usually coughed up into the pharynx and swallowed. The eggs hatch in the intestine and the first-stage larva passes out with the faeces. A few eggs may be expelled with the nasal discharge or sputum. The first-stage larva is 0·55-0·58 mm. long and has a small, cuticular knob at the anterior end and hence cannot feed. After one or two days the larva undergoes the first moult but retains the old cuticle. Three or four days after the second moult is undergone and again the old cuticle is retained—thus the larva is enclosed for a time in the skins of both the first and the second stages. Usually, however, the first-stage skin is soon cast off and the second is retained for protection. The infective larvae are not very active and have little tendency to migrate upwards on to grass. Under suitable conditions of temperature and moisture they can survive for nine months. The infection of the host takes place by the mouth, through the drinking water or by grazing over shallow marshy areas. Though they are not very resistant to desiccation they can withstand a fairly low temperature for quite a long period. On being swallowed by the host the larvae penetrate into the gut wall within three days and reach the mesenteric lymph glands through the blood vessels. They are found in large numbers in the lymph glands from two to five days after infection and undergo the third ecdysis. In the fourth-stage larva, 553 μ long, the sexes are differentiated. They pass by the lymph stream to the heart and finally are carried in the blood to the lungs where they enter the air-passages by breaking through the capillaries. Some of them may pass through the pulmonary capillaries to the systematic circulation and set up a prenatal infection in the foetus. The parasite attains maturity in about five weeks.

Pathogenesis

The adult worms living in the bronchi suck blood and as a result produce irritation of the mucosa and catarrhal bronchitis. When present in large numbers the adult worms and eggs and the exudate thrown out by the irritated mucosa occlude the air-passages and interfere mechanically with breathing. The blockage of the air-passages results in collapse of the lung tissue supplied by them and compensatory vesicular emphysema may develop. Death may occur due to suffocation. Owing to the irritation of the air-tubes there is often bronchitis present and the backward flow of the exudate containing blood-stained mucus, eggs and larvae into the smaller bronchioles and alveoli causes interstitial pneumonia. Secondary bacterial infection in the collapsed areas of the lungs may set up extensive pneumonia. The infective larvae, if in large numbers, may set up digestive disturbances while penetrating the intestinal mucosa and diarrhoea may result. The diarrhoea

may also be due to the concurrent infection with intestinal worms. In emerging from the blood capillaries into the lung tissue the larvae may cause local irritation and haemorrhage which is, however, rarely serious.

Symptoms

Usually young animals are affected though the disease may occur at all ages and is often chronic. The infected animals have a dry hacking cough which becomes loose with the progress of the disease. The cough starts about thirty days after infection and coincides with the passage of larvae in the droppings. The cough is usually strong and harsh in light infections and may be absent or soft in heavy ones. Respiration is rapid and shallow in proportion to the degree of obstruction in the air passages. Dyspnoea is generally marked and lung sounds abnormal. Often there is present a more or less profuse muco-purulent discharge from the nostrils. In heavily infected animals emaciation and anaemia are marked and oedema may be present. Unless pneumonia develops there is no rise in temperature.

Diagnosis

Generally symptoms of coughing, particularly of an epidemic nature, in young animals are suggestive of lungworm infection, which may be confirmed by the presence of first-stage larvae in the faeces. But the absence of the larvae in the faeces is not significant. On post-mortem examination the presence of red areas of collapsed lung tissue of a flesh-like consistency, and of worms, larvae and eggs in the air-passages may be looked for. When the infection is light, lesions are confined to the apices of the lungs.

Treatment

There does not appear to be any reliable medicinal treatment for the eradication of lungworms. Many veterinarians, however, believe in the practicability of treating lungworms by fumigations and intratracheal injections but opinions differ concerning the efficacy of these. The large number of drugs, alone, or in various combinations, with the different methods of administration which have been advocated, in itself throws doubt on their value. However, the principal methods of treatment are :—

1. Nutritional measures and removal of other parasites to help the animal to throw off infection rapidly.
2. Intratracheal injections.
3. Inhalation of volatile substances.
4. Administration by the mouth of drugs which are secreted through the lungs.

1. *Nutritional measures.*—Almost invariably direct lung therapy is accompanied by general nursing and tonics to improve the weakened condition of the animal,

and these probably help the *vis medicatrix naturae.* Gilruth as early as 1903 pointed out that except in cases of massive infection sheep when adequately fed and kept under otherwise favourable conditions may rapidly throw off infection without any medical treatment. Good nursing, the removal of animals from infected fields, provision of well selected nourishing food and safe drinking water, with access to salt is probably the best line of treatment. The removal of other parasites such as liverfluke and stomach and intestinal worms will considerably help the treatment.

2. *Intratracheal injections.*—In the opinion of Hall [1932] most of the treatments by intratracheal injections used for lungworms in cattle are not very satisfactory and are rather dangerous to sheep. While Hutyra and Marek [1926] state that the most serviceable procedure seems to be the intratracheal injection or vaporisation of liquids capable of killing the parasites. A large number of drugs either alone or in combination has been tried intratracheally and the following have all had advocates at one time or another; chloroform, turpentine, arsenic, carbolic acid, iodine, creosote, benzene, formol, oil of amber, black poppy oil, oil of cade, thymol, potassium picro-nitrate and pyrethrine in olive oil, etc. Carbon tetrachloride is dangerous when given intratracheally and does not kill the lungworms. McGrath [1931] tested the value of several drugs in the treatment of lungworms in young sheep by intratracheal injections and found that the mixture prepared according to the formula published by the New South Wales Department of Agriculture and containing in each dose of 4 c.c. creosote 0·5 c.c., oil of turpentine 1 c.c., chloroform 0·5 c.c. and olive oil 2 c.c. to be the safest and most effective. The dose is repeated on the second and fourth days. Tetrachlorethylene alone can kill lungworms but it may cause pneumonia and as such is not safe. The drug in doses of 1 c.c. in 2 c.c. of olive oil is safer than in the pure state. Lugol's solution of iodine and carbon tetrachloride are dangerous apart from their failure to kill lungworms. The following mixtures also have given good results in some cases:

1. Tincture iodii one part and glycerine ten parts. Dose 2 c.c., repeated two or three times at intervals of three days.

2. Acid carbolic liq. and chloroform each m. X and oil of turpentine and glycerine each oz. ij. Repeat three times every second day.

Injections should always be given by or under the directions of a Veterinary Surgeon.

3. *Inhalation.*—According to Herms and Freeborn [1916], Ransom and Hall [1920] the treatment that has been used on a large number of animals with good results is the instillation of chloroform into the nostrils of the animals, 1·5 c.c. in each, by means of a medicine dropper, the head of the animal being tilted backwards. The nostrils are then closed with the hands or with a pledget of cotton until the animal becomes unsteady on its feet. The animal is then placed in an

enclosure free from vegetation and two hours later is given a dose of Epsom salt. The treatment is repeated three times at the most at intervals of three days. Mass treatment by sulphur fumes has also been advocated. The infected animals are confined in some building in which ventilation can be controlled and just sufficient sulphur is burnt to induce strong coughing.

4. *Administration of drugs.*—Carbon tetrachloride when given by the mouth is almost entirely eliminated by the lungs and has been found to be of some use in sheep but is dangerous for cattle.

It would appear that the above lines of treatment can be only partially effective since the drugs administered through the nose or intratracheally are hindered by worm-knots or clumps of worms and exudate blocking the bronchi. Moreover, owing to the collapse of the affected parts of the lung drugs cannot be drawn by inhalation into the affected areas and may pass to the healthy parts.

Prophylaxis

The animals should be removed from infected marshy areas and put on dry pastures supplied with clean drinking water. Lungworms usually affect young animals and the infection can be avoided if they are separated from the old animals which may serve as carriers. Young animals should be pastured on dry fields. Kauzal [1934] found that once sheep become two-teeth animals they develop considerable resistance to infection and seldom suffer ill-effects. The animals should be well fed and kept free from other parasites. The pastures should not be fertilised by manure from infected animals. Kainit, lime, calcium cyanide are useful fertilisers in the control of lungworms.

DICTYOCAULUS VIVIPARUS

This occurs in the bronchi of cattle and deer and has a cosmopolitan distribution. The Dutch physician Dr. F. Ruysch* of Amsterdam called attention to the existence of the worm in calf lungs as far back as 1744 and it was later described fully by a British physician Dr. F. Nichols*. The parasite is very similar to *D. filaria* but is usually somewhat slender and shorter, and is often a very serious parasite of calves, at times being epizootic. Life-history is similar to that of *D. filaria* but the infective stage is reached in about four days. The first stage-larva found in the faeces is 0·3-0·36 mm. long and is without the anterior knob. Pathogenicity is similar to that described for *D. filaria.*

Treatment and prophylaxis are on similar lines to those suggested for the sheep lungworm. But as the worms are located in the large bronchi which are not blocked, intratracheal injections are comparatively more effective in calves than in sheep and goats. Some of the mixtures recommended for intratracheal injections are: (1) one part tincture iodii and ten parts benzol or glycerine, dose 2 c.c., (2) one part

*Quoted by Magens [1934].

beechwood creosote and ten parts glycerine, dose 2 to 4 c.c. and (3) Kennedy [1934] recommended intratracheal injections of the mixture tested by McGrath in 1931 in sheep lungworms in doses of 15 c.c. The mixture was subjected to a small control test in Australia and was found to kill most of the worms without damaging the lung. Five to ten c.c. of a solution of pyrethrine in oil (5 mg. per c.c.) has been reported to give good results in intratracheal injections.

Dictyocaulus arnfieldi

This occurs in the bronchi of the horse and donkey in many countries. Its life-cycle is not completely known but may be very similar to that of *D. filaria*. As a rule the parasite is not very pathogenic, but some authors believe that its effects are similar to those of other species of the genus causing verminous bronchitis and interstitial pneumonia. Like other lungworms it is more serious in young animals and is specially serious in donkeys. Regarding treatment little is known but symptomatic treatment as in the case of other lungworms should be applied.

Dictyocaulus unequalis

One male and three female specimens were removed from a Tibetan sheep at Mukteswar. Its life-history and pathogenicity are not known.

Metastrongylus elongatus

This is one of the most injurious parasites occurring in swine. It occurs in the bronchi and bronchioles of pigs, and accidentally man, throughout the world. It is a whitish, thread-like worm from ½ to 2 in. in length and about 1/25 and 1/12 in. in width.

Life-history

According to Monnig [1934] and Cameron [1934] the eggs of the lungworm may hatch in the bronchi or during passage through the intestine. Schwartz [1936] maintains that the eggs hatch only when they are ingested by earthworms. Heavily or even moderately infested pigs discharge incredibly large number of eggs in their droppings. Schwartz found that in experimental infection, insufficient to produce marked symptoms in pigs, as many as three million eggs may be eliminated in the droppings of a single pig during twenty four hours. The eggs when expelled with the faeces contain a larva moving sluggishly within the shell. The hatching of the eggs and further development of the larvae take place in the bodies of earthworms which swallow the faeces containing eggs. Earthworms are usually very common in hog enclosures and in permanent pastures in which manure accumulates. They are often very heavily infected. More than 2,000 larvae in various stages of development were once obtained by Schwartz from a single earthworm. The larvae develop in the walls of the oesophagus and proventriculus of the intermediate host and reach the infective or third stage in about twelve days.

They measure about 0·52 mm. in length and when infective accumulate in the blood-vessels of the earthworm. The latter do not suffer from even very heavy infestations. The larvae can remain alive in the intermediate host for months and can survive its death for about two weeks or so. Pigs get infected by swallowing infected earthworms when the larvae escape into the lumen of the intestine. The migration of the larvae from the intestine to the lungs is similar to that of *Dictyocaulus.*

Pathogenicity

Pathogenicity is similar to that of *Dictyocaulus* but usually only very slight symptoms are shown. When present in large numbers they may cause, specially in young animals, bronchitis characterised by cough and pneumonia may develop with fatal consequences. The parasites are, however, responsible for much loss in condition and retarded growth which result in considerable economic loss.

Treatment and prophylaxis

So far no suitable treatment for lungworms in pigs is known. Sanitary measures and good feeding will, however, protect the animals against worms. Infected pigs should be kept on dry ground or in sties with a pucca floor and their faeces should be disposed of in a manner which will prevent the spread of infection. Measures which will prevent rooting by pigs should be adopted. Ringing the nose of pigs controls to some extent not only lungworms but also thorny-headed worms which are acquired through eating May beetles brought to the surface by rooting.

Two more species of the genus occur in pigs, *M. pudendotectus* (*brevivaginatus*) and *M. salmi* but the pathogenicity of both is similar to that of *M. elongatus.*

PROTOSTRONGYLUS REFESCENS

This is known as the hair lungworm which lives in the small bronchioles of sheep and goats and is much smaller than *Dictyocaulus filaria.* The body has a characteristic brownish-red hue due to intestinal colouration.

Life-history

The eggs develop in the lungs and the first-stage larva passed in the faeces measure 0·25 to 0·32 mm. in length. The tip of the tail has an undulating outline but a dorsal spine is absent. For further development the larva requires an intermediate host which is usually a flat, spiral-shelled snail and reaches the infective stage in twelve to fourteen days. It is either swallowed by the snail or penetrates through the foot. The final host becomes infected by taking infected snails with the food and the larvae reach the lung through the lymphatic glands in which the larvae undergo the third moult.

Pathogenicity and symptoms

The worms live in the small bronchioles and owing to irritation produce capillary bronchitis and lobular pneumonia. The lesions which are roughly conical

in shape and yellowish grey in colour are very irregularly distributed. They are much smaller than those met with in *Dictyocaulus* infections. The pleura at the base of the focus may be involved in fibrinous pleuritis. Usually the animals show no definite symptoms, though severe infections certainly affect the general health of the animal and cause respiratory distress. The weakened lungs become susceptible to bacterial infection which may produce acute pneumonia. Diagnosis is made by finding the larvae in the faeces.

Prophylaxis

As in the case of *Dictyocaulus*, destruction of the snails, if possible, may be attempted.

A few other species of the genus are known but they all produce similar lesions.

Muellerius capillaris

This is a common lung parasite of sheep and goats in Europe and United States of America. In South Africa Le Roux, 1930, found it in imported sheep but it has not yet spread to native-bred stock, although the molluscan intermediate hosts occur there.

Life-history

The first-stage larvae passed in the faeces are 0·25 to 0·3 mm. long. They have two oesophageal swellings, one near the middle and the other at the distal extremity. The tail has an undulating tip and a dorsal spine. The larva is fairly resistant to extremes of temperatures. The larva is either swallowed by a snail or penetrates its foot and undergoes its further development in the intermediate host. A large number of slugs and snails are known to serve as the intermediate host. In about twelve days the larva reaches the infective stage and the final host becomes infected by accidental ingestion of infected snails. The infective larvae can live for a week after the death of the snail. The course of migration in the final host is the same as in *Dictyocaulus*.

Pathogenicity

The worms live in the alveoli and pulmonary parenchyma, especially subpleural tissue. The worms are usually not found in lambs under six months of age. The parasite produces greyish nodules up to 2 cm. in diameter which may become calcified. As a rule the infected animals show no symptoms, though heavy infections weaken the lungs and may interfere with the health of the animal. Diagnosis is made by finding larvae in the faeces.

Prophylaxis

No suitable treatment by drugs is known. Nursing and good feedings should be provided. Destruction of slugs by spreading lime may be attempted.

VARESTRONGYLUS PNEUMONICUS

This is a common parasite inhabiting the bronchi of sheep and goats in India. Though the pathogenicity and life-history of these worms are not known, their constant association with cases of verminous pneumonia is significant.

AELUROSTRONGYLUS OBSTRUSUS

This is a common parasite of cats in some parts of Europe and America and lives in the smaller branches of the pulmonary artery.

Life-history

The eggs are laid in the branches of the pulmonary artery and become arrested in the capillaries, and develop there. The larvae on hatching, break out into the air-passages. They are then coughed up into the pharynx, and swallowed and finally passed out in the faeces. They are then picked up by mice. They develop to the infective stage in the mouse, and cats become infected by feeding on infected mice.

Pathogenicity, symptoms and diagnosis

The adult worm appears to be non-pathogenic. The eggs arrested in the capillaries produce thrombi and a catarrhal reaction in the adjacent alveoli. But the catarrhal exudate is quickly eliminated and the thrombus resolved, so that only a slight thickening of the wall of the arteriole is seen after the larva has escaped from the egg. There are no toxic changes and the adult worm never invades the lung tissue. In heavy infections the number of eggs may be large enough to cause fatal pneumonia. The animal may cough and suffer from diarrhoea and emaciation, which may result in death, especially in the case of kittens.

Treatment is symptomatic and prevention is impracticable.

ANGIOSTRONGYLUS VASORUM

This worm usually occurs in the pulmonary artery and its branches, but is rarely found in the right ventricle of the dog. Occasionally stray forms have been recovered from other parts of the body, *e.g.*, anterior chamber of the eye

Life-history

The eggs are laid in the pulmonary capillaries where they hatch and the larvae escape into the air-passages, and pass out in the faeces *via* the trachea, oesophagus and intestine. The larva has a pointed tail with a small appendage. The rest of the cycle is not known.

Pathogenicity, symptoms and diagnosis

The eggs in the pulmonary arterioles produce nodules which may be so numerous as to cause severe dyspnoea. The tubercles are found specially at the base of the lobes. The worms have also been reported to cause ascites.

Diagnosis is usually possible only on autopsy, but in case of dyspnoea it may be possible by finding eggs in the faeces or sputum, but as a detailed description of the larvae is not available, diagnosis is only tentative.

Treatment and prophylaxis are unknown.

Oslerus osleri

This is an incompletely described parasite inhabiting the trachea and bronchi, and rarely the lungs of dogs in America, India, England and New Zealand.

Life-history is unknown.

Pathogenicity, symptoms and diagnosis

The parasites live in or under the mucosa of the trachea or bronchi and produce small tumours of less than 1 cm. in diameter. These are greyish white or pink in colour, polypoid or sessile and with cavities, in which the worms are lodged. The symptoms depending upon the severity of infection, and size of tumours, are a rasping persistent cough, loss of appetite and emaciation. Chiefly young dogs are affected and the disease is chronic and usually not fatal.

Diagnosis can be made by bronchoscopy or by finding larvae which have an S-shaped tail in the faeces.

Treatment and prevention are little known.

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EXPERIMENT ON MARKING CATTLE FOR IDENTIFICATION PURPOSES

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Introduction

There are several methods of marking cattle for identification purposes, *viz.*, (1) tattooing in the ears, (2) cutting pieces out of the ears or notching, (3) branding numbers on horns, (4) putting number clips on the ears, (5) hot iron branding, and (6) branding with Brand-em-al solution. All the methods, more or less, cause pain. Some methods of marking are not lasting and are not visible unless the animal is secured. Some cause disfigurement and this reduces the value of the hide. One of the first essentials in numbering or marking cattle on a farm is that the number should be plainly visible from a fair distance, say twenty yards. Only two of the above methods, therefore, fulfill this requirement satisfactorily :—

(1) Hot iron branding and (2) branding with Brand-em-al solution with number irons. These two methods were, therefore, tried to find out which was the more lasting and humane.

Hot iron branding *vs.* marking by Brand-em-al ink

Hot iron branding method.—At the Imperial Dairy Institute the cattle have, for a number of years, been numbered with four-in. hot iron brands lightly pressed on the hind quarters. These numbers have been found to give a lasting impression and are visible during the whole life of an animal even upto sixteen years. The labour and trouble involved in marking by this method is not more than in the other methods. After branding, the burns are rubbed with camphor oil for two or three days and they heal in ten days or so, leaving thin scabs, if the branding is done lightly and evenly (Plate XXXVII, fig. 1). The damage to the skin is very slight, in fact negligible and does not reduce the value of the skin when sold.

Fig. 1. Branded on 2nd April 1936 Photo taken the same day. 1-in hot iron used.

Fig. 2. Branded on 2nd April 1936. Photo taken on 2nd June 1936.

FIG. 1. Branded with 4-in branding iron with Brand-em-al solution on 2nd April 1936. Photo taken on 2nd May 1936.

FIG. 2. Branded on 2nd April 1936 with 4-in. iron with Brand-em-al solution. Photo taken on 2nd May 1936. Solution burnt into skin $\frac{1}{6}$ in. deep.

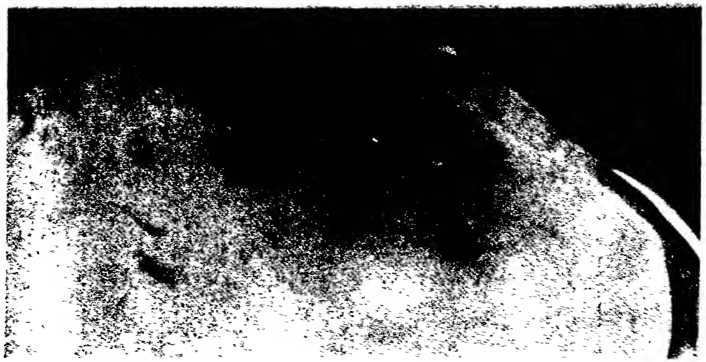

FIG. 3. Branded on 2nd April 1936 with $2\frac{1}{2}$-in. iron with Brand-em-al solution. Photo taken on 2nd May 1936. The figure is distorted due to spreading of solution by coming in contact with water.

FIG. 4. Branded with Brand-em-al solution with hairs not shaved. Photo taken on 2nd July 1936 Parts of numbers indistinct.

Method of branding by Brand-em-al ink.—The Brand-em-al ink is a chemical solution which has been patented. It was tried on over fifty cows and more than ten buffaloes at the Institute. The labour and trouble in this was much more than in the fire brand method. With the branding ink method the animal has to be checked from licking the solution to prevent it from blistering its tongue and spoiling the numbers. Its tail also should not be permitted to be switched over the number as the solution would otherwise spread and disfigure the numbers. Two sizes of numbers 2½ in. and 4 in. were used in this experiment. One of the great difficulties encountered in the solution method was the control of the depth to which the solution should burn into the skin. Sometimes it was too light and consequently the numbers disappeared in a month's time (Plate XXXVIII, fig. 1). Others which were burnt 1/6 in. deep into the skin took over a month to heal (Plate XXXVIII, fig. 2) and definitely spoiled the skin for marketing purposes. Another trouble which was found in the solution method was, that after numbering and upto a period of fourteen days, if the raw surface came into contact with water the solution ran out and the burn was spread (Plate XXXVIII, fig. 3). Consequently the numbers became distorted and this necessitated re-branding the animal. One more difficulty which was found was with animals with rough coats. If the hairs were not shaved before branding with the solution it did not burn evenly and thus only parts of the numbers were burnt into the skin (Plate XXXVIII, fig. 4) and the numbers were not clearly cut as in the case of the hot iron branding (Plate XXXVII, fig. 2) due to the hair interfering with the action of the solution.

Again with the circular Rinderpest Inoculation brands (circular brands were used in this experiment) it was found that with the 2½-in. circular brand the solution ate under the skin and the whole circle formed a scab which dropped off leaving a bare patch (Plate XXXIX, fig. 1). On the other hand with the 4-in. circular brand slightly better results were obtained. These proved to be of a temporary nature as later on contraction of the skin followed with the result that the hair covered the brand rendering it not easily visible after three or four months (Plate XXXIX fig. 2). The 4-in. circular hot iron brand made a distinct circle which was visible even from a distance of over twenty yards nine months after branding (Plate XXXIX, fig. 3).

Comparison of the merits of the two methods

The hot iron branding is less painful and irritating, and can be soothed in two or three days with the application of camphor oil. The burns do not become raw nor do they fester and they can be washed and dressed without inconveniencing the animal and disfiguring the numbers. The animals branded by this method rarely require re-branding during their life. The Brand-em-al solution on the other hand was found to give rise to soreness and irritation to the skin of the animals for days, and this made them lick the brands until they became red, raw and disfigured. Again the numbers, when sore, could not be washed nor cleaned, as

the solution either ran out or became ineffective. It was found that all the solution numbers became raw and took four to six weeks before they dried up and dropped their scabs (Plate XXXVIII, fig. 2). In some cases even when deeply burnt with the solution the numbers disappeared in parts after a couple of months (Plate XXXIX, fig. 4), necessitating re-branding of the animal. This not only disfigures the animal while alive, but damages the skin and makes it unfit for sale after the death of the animal.

Conclusion

From the experience gained of marking large numbers of cattle by the two methods mentioned above, it can be definitely said that branding with the hot iron gives the most satisfactory results when looked at either from the humane or practical point of view. It is less painful to the animal in the long run, the numbers obtained by it are more easily visible from a distance, cause the least disfigurement to the animals and are very lasting.

FIG. 1. Branded on 2nd December 1935 with $2\frac{1}{2}$-in brand with Brand-em-al solution. Photo taken on 2nd April 1936. Solution has eaten completely under scab and left a bare patch and not a circle.

FIG. 2. The brand mark with Brand-em-al ink has more or less disappeared.

FIG. 3. Hot iron brand—Nine months after branding.

FIG. 4. Photo taken on 2nd January 1937—Nine months after branding with Brand-em-al solution.

THE QUALITY OF SUGARCANE IN NORTHERN INDIA IN RELATION TO BORER INFESTATION AND DISEASE INFECTION

BY

JOHN H. HALDANE, Ph.D., F.I.C.

During the month of February, 1937, a borer survey was made over the supplies of cane delivered to ten factories, the operations of which are controlled by Messrs. Begg Sutherland & Co., Ltd. These factories are Chanpatia, Barrah, Samastipur, Ryam and Marhowrah, situated in North Bihar, and Purtabpore, Tamkohi, Gauri, Balrampur and Tulsipur, situated in the eastern area of the United Provinces. The small-scale map given below indicates the relative position of each factory in Northern India at which the survey was carried out.

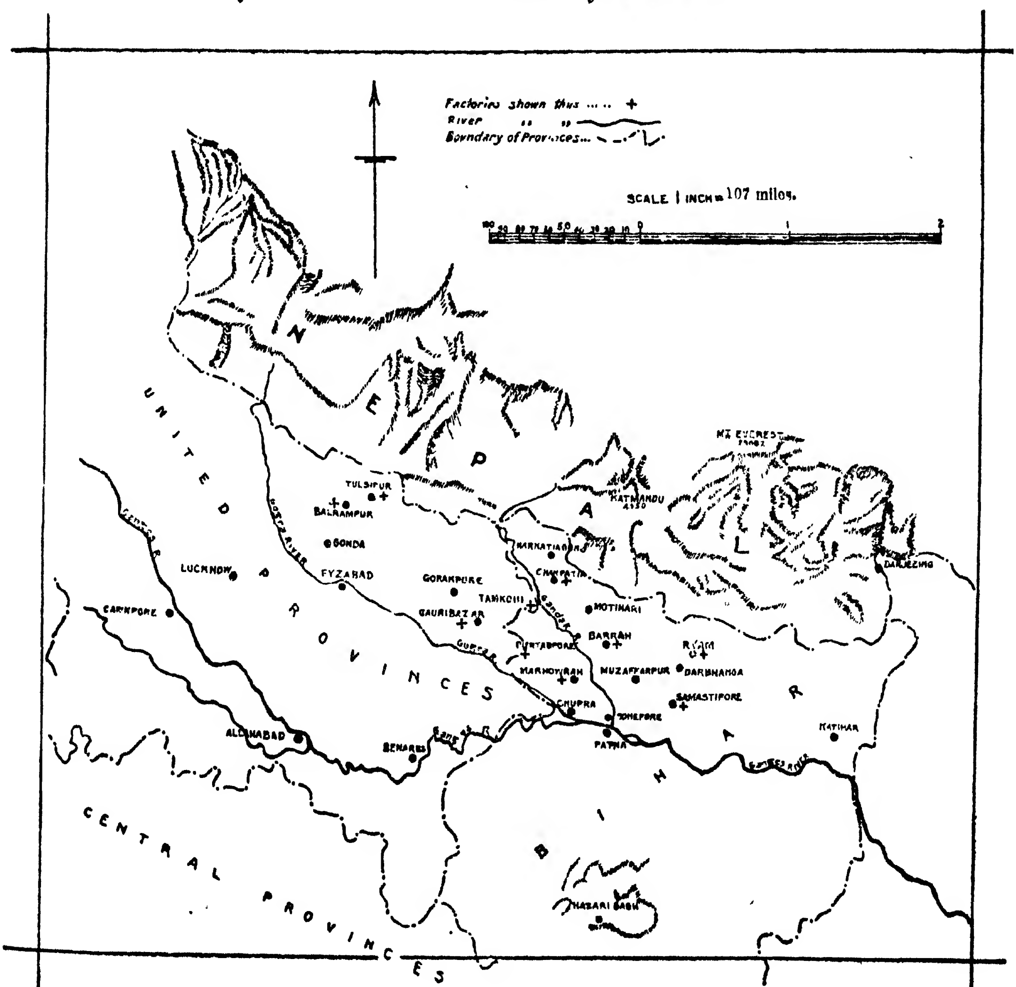

Fig. 1.

The examination of the cane was made at the factories and every precaution was taken to make the survey representative (*a*) of the areas whence supplies of cane were drawn and (*b*) of the material delivered. The procedure adopted was to draw at random from the cane carts or railway wagons, the source or area from which the cane was drawn being known, fifty to one hundred stalks of cane. The stalks were then split lengthway and after a count of the number of sound and infested stalks, weighment of the sound and infested cane was made. A stalk, although only showing a slight degree of infestation, was classed as infested and these latter included canes which, while not showing evidence of actual wound injury from borer, presented symptoms of disease as shown by the presence of discoloured fibre. Finally, the sound and infested canes were subjected to analysis which included the determination of solids, sugar and purity of the juice expressed by a hand mill. From these analyses ; passage to the composition of the cane and to the yield of sugar in the factory was made according to the following scheme.*

Let B_h=Brix of Hand Mill Juice

P_h=Polarisation of Hand Mill Juice

Accept B_h-0·005=Brix of Factory Primary Juice=B_f

P_h-0·007=Sugar of Factory Primary Juice=S_f

S_f/B_f=Gravity Purity Primary Juice

To connect primary juice and sugar in cane proceed :—

Sugar in sound cane $=S_s=0\cdot79\ S_f$

Sugar in borer infested cane $=S_b=0\cdot76\ S_b$

Let e be the pre-determined mill extraction and m be the pre-determined virtual purity of waste molasses.

Then factory yield for sound cane $=eS_s\ (j\text{-}m)/j(1\text{-}m)$

and factory yield for borer infested cane$=eS_b(j\text{-}m)/k(1\text{-}m)$

Example

Proportion of sound cane	=0·800
Proportion of borer infested cane	=0·200
Brix Hand Mill Juice from sound cane	$=0\cdot180=B$
Brix Hand Mill Juice from infested cane	$=0\cdot165=B_h$
Polarisation of Hand Mill Juice from sound cane	$=0\cdot150=P_h$
Polarisation of Hand Mill Juice from infested cane	$=0\cdot130=P_h$
Then Primary Juice Brix from sound cane	$=0\cdot175=B_f$

*This scheme was developed as a result of an examination of many hand-mill analyses in relation to actual factory returns.

Then Primary Juice Brix from infested cane $= 0 \cdot 160 = B_f$

Then Primary Juice Sugar from sound cane $= 0 \cdot 143 = S_f$

Then Primary Juice Sugar from infested cane $= 0 \cdot 123 = S_f$

Purity of Juice from sound cane $= 0 \cdot 143 / 0 \cdot 175 = 0 \cdot 817$

Purity of juice from infested cane $= 0 \cdot 123 / 0 \cdot 160 = 0 \cdot 769$

Sugar in sound cane $= 0 \cdot 79 \times 0 \cdot 143 = 0 \cdot 113$

Sugar in infested cane $= 0 \cdot 76 \times 0 \cdot 123 = 0 \cdot 093$

Let $e = 0 \cdot 94$ and $m = 0 \cdot 35$

Then yield from sound cane $= (0 \cdot 113 \times 0 \cdot 94)(0 \cdot 817 - 0 \cdot 35) / 0 \cdot 817 (1 - 0 \cdot 35)$
$= 0 \cdot 0934 = 9 \cdot 34$ per cent.

Then yield from borer infested cane $= (0 \cdot 093 \times 0 \cdot 94)(0 \cdot 769 - 0 \cdot 35) / 0 \cdot 769$
$(1 - 0 \cdot 35) = 0 \cdot 0732 = 7 \cdot 32$ per cent.

Finally, yield in the factory $= 0 \cdot 8 \times 9 \cdot 34 + 0 \cdot 2 \times 7 \cdot 32 = 8 \cdot 93$ per cent.

At each unit, several areas were examined daily and at the end of the survey, the results were totalled and averaged for each respective area. According to the percentage proportion of supplies from each area, the yield of sugar was de termined to obtain a direct comparison with the actual results recorded by the factory for the month of February and so afford some indication of the sugar losses due to borer infestation and disease infection.

In Schedules I to X are given the detailed results of the borer survey carried out at Chanpatia, Barrah, Samastipur, Ryam, Marhowrah, Purtabpore, Tamkohi, Gauri, Balarampur and Tulsipur factories respectively.

Chanpatia.—From Schedule I it will be observed that eleven areas were surveyed and from a total of 5,300 stalks of cane examined, 2,580 stalks were found to be infested, indicating a 48·7 per cent degree of infestation and the statement shows that the degree of infestation is fairly uniform for all areas examined.

According to the proportion per cent total supplies from each area and the results of analyses of sound and infested cane on a weighted average basis, the estimated yield of sugar from sound cane is recorded at 11·27 per cent as compared with 8·96 per cent for infested cane while the average yield from mixed cane, *i.e.*, sound and infested, is quoted at 10·13 per cent which compares very favourably with the actual recorded yield of 10·05 per cent by the factory for the month of February. A decrease in the sugar-yield from 11·27 per cent to 10·13 per cent indicates a loss of approximately 9 per cent of the available commercial sugar in the cane and as this unit crushed 5,88,537 maunds of cane during the month of February the loss of commercial sugar due to borer attack and disease may be quoted at $5{,}88{,}537 \times (11 \cdot 27 - 10 \cdot 13)/100 = 6{,}709$ maunds.

Barrah.—Twelve areas were surveyed at this unit, and Schedule II indicates that 2,941 stalks were infested from a total of 8,500 stalks examined, representing an infestation degree of 34·6 per cent. Apart from area No. 8, which records 53·8 per cent infestation, the other areas appear to be infested to approximately the same degree.

The analyses results from this survey indicate that the yield of sugar from sound cane would have been 10·57 per cent as compared with 8·05 per cent for infested supplies, while the average yield from mixed supplies is recorded at 9·76 per cent which compares very favourably with the actual yield of 9·68 per cent recorded by the factory for the month of February. As this unit crushed 5,85,136 maunds of cane during the month under review the loss of sugar due to borer and disease may be calculated as 5,85,136 × (10·57—9·76)/100=4,740 maunds.

Samastipur.—Schedule III indicates that twenty-one areas were surveyed at this unit and from a total of 4,500 stalks of cane examined, 1,567 stalks were found to be infested, representing an infestation of 34·82 per cent. The lowest degree of infestation is recorded at 13·0 per cent while the maximum is given as 55 per cent which indicates the variation in borer infestation as from area to area whence this unit draws its cane supplies.

The analyses results indicate that this unit would have recorded a yield of 10·76 per cent from sound cane as compared with 6·98 per cent from infested cane while the estimated yield from mixed supplies based on a weighted average basis is given as 9·38 per cent which compares quite favourably with the actual yield of 9·56 per cent recorded by the factory for the month of February. Since this unit crushed 5,02,596 maunds of cane during the month of February, the loss of commercial sugar due to borer infestation and disease infection may be calculated as 5,02,596 × (10·76—9·38)/100=6,936 maunds, indicating a sugar loss of 1·38 per cent on cane.

Ryam.—Supplies by cart (local), tramway and railway were surveyed and from an examination of 3,400 stalks of cane, 1,903 stalks were found to be infested, indicating 55·97 per cent infestation degree. The high degree of infestation, as indicated in Schedule IV, is borne out by the relative low sugar-yield of 6·16 per cent from infested cane as compared with 11·23 per cent from sound cane while the average yield based on the proportion per cent total supplies from each area for the month of February is given as 8·48 per cent which compares quite favourably with the actual yield of 8·64 per cent recorded for the month under review. Since this factory crushed 5,10,920 maunds of cane during the month of February, the loss of sugar due to borer and disease may be estimated at 5,10,920 × (11·23—8·48)/100=14,053 maunds equivalent to a depression in the available sugar yield of approximately 24·5 per cent.

Marhowrah.—This unit draws its cane supplies from eight areas, and from Schedule V it will be noted that 2,150 stalks of cane were examined, out of which

865 stalks were found to be infested, representing a 40 per cent degree of infestation. A count of the relative frequency of borer infestation and of symptoms of disease in the absence of wound injury was also made and of the unsound cane 85 per cent was distinctly due to root, stem and top borers.

According to the proportion per cent total supplies from each area, the yield of sugar from sound cane during the month of February would have been 11·52 per cent as compared with 8·30 per cent from infested cane while the average yield from mixed supplies is given as 10·15 per cent which compares very favourably with the actual yield of 10·10 per cent recorded by the factory. As this (unit crushed 6,13,251 maunds of cane during the month of February, the loss of commercial sugar due to borer and disease appears as 6,13,251 × (11·52—10·15)/100= 8,401 or a depression in the available sugar-yield of approximately 12 per cent.

Purtabpore.—Four areas were examined by this unit, and during the survey 7,168 stalks were examined, 2,230 of which were found to be infested, representing a 31·11 per cent degree of infestation. From Schedule VI, it may be noted that railway supplies were found to be infested to the extent of 52·27 per cent as compared with 20·54 per cent for supplies from the Mairwa area which indicates the variation in borer infestation as from area to area whence this unit draws its cane supplies.

The analyses results indicate that this unit would have recorded a yield of 10·84 per cent if all supplies had been sound, whereas the estimated yield from mixed supplies is given as 9·86 per cent which compares favourably with the actual yield of 9·67 per cent recorded by the factory for the month of February. Since this unit crushed 5,13,803 maunds of cane during the month under review, the loss of commercial sugar due to borer attack and disease may be estimated as 5,13,803 × (10·84—9·86)/100=5,035 maunds.

Tamkohi.—Schedule VII gives the detailed results of the borer survey carried out at this unit during February from which it may be noted that the average per cent degree of infestation is recorded at 45·68 per cent. The lowest degree of infestation is given as 34·66 per cent while the maximum is recorded at 53·42 per cent.

According to the results of analyses of sound and infested cane, the average yield from mixed supplies is estimated at 9·67 per cent as compared with an actual yield of 9·81 per cent recorded by the factory, whereas if all supplies had been sound, the estimated yield would have been 10·80 per cent. As this unit crushed 5,96,258 maunds of cane during the month of February, the loss of sugar due to borer damage and disease may be estimated at 5,96,258 × (10·80—9·67)/100=6,738 maunds.

Gauri Bazar.—A total of 2,700 stalks were examined during the survey and the infestation degree amounted to 17·33 per cent.

According to the proportion per cent total supplies from each area and the results of anslyses of sound and infested cane, as given in Schedule VIII, the estimated yield of sugar from sound cane, on a weighted average basis, is given as 10·74 per cent as compared with 8·52 per cent for infested cane, while the average yield from mixed cane is quoted at 10·47 per cent which compares favourably with the actual yield of 10·63 per cent recorded by the factory for the month of February. Based on the maundage of cane crushed by this factory during the month under review, the loss of commercial sugar due to borer attack and disease is estimated at 1,157 maunds.

Balrampur.—In Schedule IX are collected the data relating to the borer survey carried out at this unit during the month of February 1937. The total number of stalks examined amounted to 1,800, out of which 437 were found to be infested, representing an infestation degree of 24·28 per cent and from the areas examined it may be noted that the infestation is fairly uniform.

The analyses results indicate that the yield of sugar from sound cane would have been 11·39 per cent as compared with 8·13 per cent for infested supplies while the average yield from mixed supplies, *i.e.*, sound and infested, is given as 10·62 per cent. The latter estimated yield compares quite favourably with the yield of 10·49 per cent recorded by the factory for the month of February. Based on the estimated yields from sound and infested supplies, and on the quantity of cane crushed by this unit during February, the loss of sugar due to borer and disease is estimated at 3,882 maunds.

Tulsipur.—At this unit six areas were surveyed and the average degree of infestation, as indicated in Schedule X, is given as 26·27 per cent. Supplies from Jarwa area were found to be infested to the extent of 45·16 per cent as compared with only 18·62 per cent for Bankatwa area which gives an indication of the variation in borer attack as from area to area.

The results of analyses of sound and infested cane indicate that the yield from sound cane would have been 10·83 per cent as compared with 9·37 per cent for infested supplies, while the average yield from mixed supplies is recorded at 10·47 per cent which compares very favourably with the actual yield of 10·50 per cent reported by the factory for the month of February. The estimated loss of commercial sugar due to borer and disease is recorded as 1,708 maunds.

In Schedule XI are collected the principal data relating to the results of the borer survey carried out during the month of February at ten factories situated in Northern India. A total of 40,071 stalks of cane were examined and 14,571 were found to be infested, representing an average degree of 36·36 per cent infestation. With reference to the totals and averages for the group of factories, it may be noted that the estimated yield of sugar from sound cane for the month of February would have been 11·01 per cent as compared with a yield of 8·08 per cent for infested supplies while the average yield on mixed supplies is given as 9·89 per cent which compares very favourably with the actual yield of 9·91

per cent recorded by the group. Based on total cane crushed, the estimated loss of commercial sugar by the group, due to borer and disease infection is given as 59,359 maunds.

As a result of this survey, combined with an examination of statistics of record, the writer feels justified in making the following statements :—

1. The sugarcane crop in North Bihar and Eastern United Provinces is infested with various species of borer.
2. Associated with the wound injury by the borer, opportunity is offered for the entry into the plant tissues of micro-organisms responsible for the destruction of large quantities of sugar.
3. In the majority of cases the node formed a barrier preventing the spread of the infection by micro-organisms from one internode to those adjacent. In some cases, this barrier was not effective.
4. Instances were observed of a wide-spread pathogenic condition independent of borer injury. These canes often presented a parenchyma of a yellowish-red coloration with or without the presence of red streaks.
5. In the case of top borer, in well-tended crops, the upper buds sprouted and normal growth followed.
6. The Coimbatore varieties of cane, chiefly Co. 210 and Co. 213, grown in North Bihar and Eastern United Provinces appear to be tolerant to borer attack in the sense that in the presence of extensive infestation normal growth and remunerative crops can be obtained. Instances of this condition were found at Barrah, Dowlatpore, Purtabpore and Tamkohi Estates where high yields were obtained per acre and yet the degree of infestation approximated 40 per cent.
7. Attention is now specifically called to this condition of borer infestation as the evidence, as shown below giving the degree of infestation as determined in season 1935-36 and in February 1937, would appear to point to one of progressive increment.

Per cent degree infestation

	Season 1935-36	1937
Chanpatia	18·8	48·7
Barrah	30·2	34·6
Samastipur	11·5	34·8
Ryam	19·5	56·0
Marhowrah	26·0	40·0
Purtabpore	15·3	31·1
Tamkohi	Unknown	45·7
Gauri Bazar	12·5	17·3
Balrampur	14·0	24·3
Tulsipur	Unknown	26·3

8. The annual loss due to borer reaches very large sums which fall in part on the grower and in part on the miller. From Schedule XI, the group average weight per 1,000 stalks of cane appears as 453 seers for sound cane as compared with 434 seers for infested cane, representing a loss of approximately 4 per cent of the weight of the crop which falls entirely on the grower. This loss is based on the variation in weight per 1,000 stalks infested and sound cane as delivered at the factory and does not take into consideration the actual field loss since the grower will only deliver cane which will be accepted and not refused by the factory. Attention may also be called to the variation in weight per 1,000 stalks of sound cane as recorded by each factory, *e.g.*, the weight per 1,000 stalks of sound cane at Barrah is given as 331 seers as compared with 654 seers at Balrampur.

9. The estimated loss of sugar due to borer and disease by the Group of ten factories during the month of February is given as 59,359 maunds or a financial loss per month of some Rs. 3,50,000, quoting sugar at Rs. 6 per maund. On a season of five months the loss may be estimated at Rs. 17,50,000.

10. Apart from the loss to the grower and miller, the question has a national aspect in so far as the Excise and Imperial Revenues suffer from the depleted yield. In item 9, the estimated seasonal financial loss by the Group of ten factories is given as Rs. 17,50,000 and taking the Sugar Excise Duty as Rs. 1-8-0 per maund of sugar, the revenue loss to Government would approximate, say, Rs. 4,30,000.

11. Since there are 65 factories operating in North Bihar and Eastern United Provinces and assuming that the quality of cane milled by the Group of ten factories is representative of the supplies to all factories, the revenue loss on Sugar Excise to Government during season 1936-37 may be estimated to approximate Rs. 28,00,000.

12. The supply of sound cane to all factories would result in an increase of approximately 1 per cent in the yield of sugar and a considerable reduction in the production of waste molasses, a by-product, the disposal of which is causing considerable anxiety to factory owners. In addition, the improved quality of the raw material would permit of the production of a more uniform and better quality of final product, namely, sugar.

Independent of the annual overhead loss to grower, miller and Government, the uncontrolled infestation of the cane crop constitutes a severe menace to the stability of the sugar industry in North Bihar and the Eastern United Provinces. Of seed selection and nurseries for the growing and distribution of clean sound seed, there is a deficiency compared with the magnitude of the industry but, from

what has been stated, it is apparent that it is of the utmost importance that Government, through the Provincial Government Agricultural Departments, offer immediate assistance to check, reduce or eradicate this infestation. Suppression or entire elimination of the system of crop ratooning, removal and collection of leaves and trash for compost manufacture immediately the crop has been cut, restriction of the areas under cane to ensure that the crop can be harvested before the plant cane has germinated, improved agricultural methods, will undoubtedly reduce the degree of infestation but the seriousness of the infestation as revealed by this survey calls for immediate investigation by the Provincial Government Agricultural Departments.

The Government of India and Provincial Governments are deeply interested in the well-being of the sugar industry and, as Government has devoted a portion of the funds accruing from the Sugar Excise Duty, it is strongly suggested that here lies an opportunity for an investment of these funds which will not only re-act to the benefit of the industry but will at the same time increase the industry's contribution to the Imperial Revenue.

Schedule I

Champatia Factory

Area	Sound cane						Infested cane						Average yield	Prop. per cent total supplies from area	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Degree of borer and disease on No. of stalks
	No. of stalks	Wt. in seers	Brix	Purity	Sugar per cent	Yield	No. of stalks	Wt. in seers	Brix	Purity	Sugar per cent	Yield						
Loheria	246	84-13	19·62	86·27	13·37	11·47	204	84-6	18 21	82 35	11·01	9·06	10·27	12·44	1·28	1·43	1·13	45·34
Sathi	422	170-13	19·44	86·97	13·36	11·41	428	185-2	17·77	80·32	10·87	8·96	10·14	10·18	1·03	1·16	0·91	50·35
Kooreah 1	241	93-11	19·28	85·86	13·08	11·12	259	113-5	18·08	81·59	10·90	9 04	9·98	7·08	0·71	0·79	0·64	51·80
Kooreah 2	274	97-13	19·18	86·46	13·04	11·14	226	88-0	18·11	81·72	10·91	9·02	10·14	18·15	1·84	2·02	1·64	45·20
Bagaha	258	113-4	19·45	86·05	13·29	11·45	242	108-3	18·12	81·37	11·03	9·14	10·32	5 60	0·58	0·64	0·51	48·40
Parsa	223	86-1	19·24	86·32	13·17	11·41	227	91-13	18·06	80·09	10·88	8·97	10·15	7·24	0·73	0·83	0·65	50·45
Khairpokra	220	99-10	20·23	86·75	13·72	11·84	230	103-11	18·05	81·45	10·72	8·81	10·29	6·11	0 63	0·72	0·54	51·11
Sirsea	183	72-8	19·47	87·25	13·43	11·61	167	71-0	18 22	82 56	11·03	9·27	10·45	0·66	0·07	0·08	0·06	47·71
Bettiah	227	81-5	19·15	85·97	12·83	11·01	173	66-5	17·67	80·76	10·87	8 91	10·07	27·14	2·73	2·99	2·42	43·25
Sikta	195	73-2	18·53	84·71	12·44	10·65	205	79-5	16·57	78·99	9·99	8·03	9·29	1·87	0·17	0·20	0·15	51·25
Bhairoganj	231	85-6	19·76	86·45	13·49	11·67	219	89-1	18·03	81·27	10·91	8·92	10·27	3·53	0·36	0·41	0·31	48·67
Totals and Averages.	2720	1058-6	19·42	86·34	13·23	11·36	2580	1080·3	17·91	81·08	10·84	8·93	...	...	10·13	11·27	8·96	48·68

Factory Results :—Cane crushed during February . . . . 5,88,537 maunds.
Sugar made during February . . . . 59,160 maunds.
Yield of sugar per cent cane . . . . 10·05 per cent.

Borer Survey :— Yield of sugar per cent cane from mixed supplies . . . . 10·13 per cent.
Yiled of sugar per cent cane from sound cane . . . . 11·27 per cent.
Yield of sugar per cent cane from infested cane . . . . 8·96 per cent.

Loss of sugar due to borer and disease 5,88,537 × (11·27—10·13)/100 = 6,709 maunds.

Schedule II

Barrah Factory

Area	Sound cane: No. of stalks	Sound cane: Wt. in seers	Sound cane: Brix	Sound cane: Purity	Sound cane: Sugar per cent	Sound cane: Yield	Infested cane: No. of stalks	Infested cane: Wt. in seers	Infested cane: Brix	Infested cane: Purity	Infested cane: Sugar per cent	Infested cane: Yield	Average yield	Prop. per cent total supplies from area	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Degree of borer and disease on No. of stalks
No. 1 . .	538	188-4	19·03	82·78	12·47	10·35	262	87-4	16·85	77·73	10·06	7·88	9·57	14·05	1·34	1·45	1·11	32·7
No. 2 . .	552	177-10	19·75	83·75	13·06	10·92	248	75-4	17·66	80·37	10·79	8·69	10·26	14·96	1·54	1·63	1·30	31·0
No. 3 . .	545	175-12	19·63	83·67	13·02	10·89	255	87-0	17·15	78·04	10·12	8·04	9·95	9·42	0·94	1·03	0·76	31·9
No. 4 . .	436	129-4	19·69	83·84	13·00	10·92	214	63-4	17·46	79 90	10 71	8·60	10·16	1·99	0·20	0·22	0·17	32·9
No. 5 . .	443	143-4	19 06	83·61	12·58	10·50	207	63-4	17·06	79·91	10·37	8·28	9·82	5·72	0·56	0·60	0·47	31·8
No. 6 . .	447	142-12	19·60	84·02	13·01	10·91	203	62-4	17·34	79·08	10·45	8·34	10·13	4·87	0·49	0·53	0·41	31·2
No. 7 . .	491	155-0	19·33	82·94	12·64	10·51	209	62-12	17·24	77·48	10 17	7·95	9·77	11·92	1·16	1·25	0·95	29·8
No. 8 . .	346	175-8	19 04	82·62	12 17	10·10	404	197-8	16·32	77·71	9·63	7·56	8·76	3·62	0·32	0·37	0·27	53·8
No. 9 . .	431	153-0	18·82	83·28	12 38	10·35	219	76-13	16·37	78·42	9·77	7·65	9·45	11·99	1·13	1·24	0·92	33·7
No. 10 . .	457	143-4	19·52	82·46	12 58	10·43	243	71-12	17·27	77 57	10·19	8·00	9·62	7·98	0·77	0·83	0·64	34·7
No. 11 . .	417	113-9	19 64	82·71	12·89	10·85	233	58-5	17·71	78·14	10·51	8·31	9 99	2·99	0·30	0·32	0·25	35·8
No. 12 . .	456	154-12	19·18	83·59	12 53	10·52	244	77-8	16·68	77·43	9·83	7·63	9·56	10·49	1·00	0·10	0·80	34·8
Totals and Averages.	5559	1851-15	19·35	83 27	12·68	10·60	2941	982-14	16·97	78·35	10·12	7·99	...	...	9·76	10·57	8·05	34·6

No. 1 Area—Pipra-Mehsi
No. 2 Area—Kanti-Mahwal
No. 3 Area—Muzaffarpur-Silout
No. 4 Area—Jiudhara-Ramgarhwah
} Rail supplies.

No. 5 Area—Patani-Madhuban
No. 6 Area—Tateriah-Madhuban
No. 7 Area—Departmental-Madhuban
} Tramway supplies.

No. 8 Area—Barrah-Russalpur-Mahuwah Zeerat
No. 9 Area—Barrah-Mahuwah-Parsauni-Pakri
No. 10 Area—Pakri Balli-Russalpur-Madhopur
No. 11 Area—Jagaulia-Khodapur
No. 12 Area—Karnaul-Naik Singh-Leyakat Hussain
} Gate cart cane.

Factory Results :—Cane crushed during February . . 5,85,136 maunds.
Sugar made during February . . 56,616 maunds.
Yield of sugar per cent cane . 9·68 per cent.

Borer Survey :— Yield of sugar from mixed cane . 9·76 per cent.
Yield of sugar from sound cane . 10·57 per cent.
Yield of sugar from infested cane . 8·05 per cent.

Loss of sugar due to borer infestation and disease 5,85,136 × (10·57—9·76)/100 = 4,740 maunds.

SCHEDULE III

Samastipur Factory

Area	Sound cane						Infested cane						Average yield	Prop. per cent total supplies from area	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Degree of borer and disease on No. of stalks
	No. of stalks	Wt. in seers	Brix	Purity	Sugar per cent	Yield	No. of stalks	Wt. in seers	Brix	Purity	Sugar per cent	Yield						
Pusa Road	126	64	18·80	85·29	12·10	10·04	74	39	16·75	77·28	9·30	7·24	8·98	11·96	1·07	1·20	0·84	37·00
Mahaddipur	152	53	19·21	87·04	12·61	10·57	148	51	15·54	80·30	8·94	6·92	8·78	3·05	0·27	0·32	0·21	49·33
Dalsingsarai	131	58	19·51	87·13	12·85	10·76	69	32	16·88	78·88	9·70	7·59	9·63	7·63	0·73	0·82	0·58	34·50
Muktapur	135	61	19·79	87·54	13·10	11·12	165	75	15·56	78·74	8·78	6·71	8·69	6·05	0·53	0·67	0·41	55·00
Teghra	148	8	19·09	85·23	12·30	10·21	52	20	16·82	77·60	9·40	7·11	9·42	1·27	0·12	0·13	0·09	26·00
Jeetwarpur	133	78	18·39	86·36	11·95	10·02	67	30	16·39	79·89	9·11	7·24	9·25	2·05	0·19	0·21	0·15	33·50
Aeloth	57	21	20·17	87·80	13·40	11·40	43	16	17·27	81·97	10·20	8·22	10·02	0·25	0·03	0·03	0·02	43·00
Dholi	161	76	19·61	87·32	12·95	10·99	39	16	17·31	81·08	10·10	8·02	10·47	13·20	1·38	1·45	1·06	19·50
Hansauli	263	118	19·19	86·90	12·60	10·57	137	63	16·42	79·58	9·36	7·21	9·40	4·78	0·45	0·51	0·34	34·25
Angarghat	269	110	19·46	87·34	12·85	10·81	131	50	15·42	77·34	8·82	6·77	9·55	6·32	0·60	0·68	0·43	32·75
Mesaina	123	66	20·25	87·80	13·50	11·51	77	35	17·57	82·19	10·40	8·39	10·43	2·01	0·21	0·23	0·17	38·50
Baseedpur	155	46	19·15	87·14	12·57	10·46	45	17	16·62	79·75	9·50	7·38	9·63	1·28	0·12	0·13	0·09	22·50
Ruseraghat	113	77	20·09	86·94	13·20	11·14	87	58	15·19	75·43	8·19	5·99	8·93	23·11	2·06	2·57	1·38	43·50
Shapur Paturi	128	35	19·96	84·83	13·08	10·83	72	22	16·93	78·54	9·58	7·32	9·48	0·82	0·08	0·09	0·06	36·00
Harsinghpur	270	91	19·39	86·37	12·62	10·51	130	44	16·69	79·43	9·50	7·32	9·47	5·68	0·54	0·60	0·42	32·50
Mahnar Road	159	86	20·00	86·54	13·10	10·94	41	23	16·90	79·57	9·65	7·44	10·20	1·21	0·12	0·13	0·09	20·50
Khanpur	87	20	20·12	87·52	13·30	11·31	13	3	17·57	81·04	10·20	8·03	10·88	0·70	0·08	0·08	0·06	13·00
Bachwara	133	47	19·17	86·44	12·51	10·46	67	24	15·89	80·04	9·15	7·14	9·34	1·84	0·17	0·19	0·13	33·50
Narhan	68	19	19·47	87·41	12·80	10·90	32	11	16·06	77·64	10·77	6·78	9·39	4·25	0·40	0·46	0·29	32·00
Dudhpura	51	17	19·54	88·43	13·10	11·15	49	16	15·50	79·48	8·80	6·74	8·99	0·34	0·03	0·04	0·02	49·00
Local Ryotti	71	26	18·80	86·17	12·20	10·20	29	12	14·89	77·97	8·30	6·27	8·96	2·20	0·20	0·22	0·14	29·00
Totals and Averages.	2933	1227	19·45	86·77	12·76	10·71	1567	657	16·21	78·94	9·23	7·10	...	...	9·38	10·76	6·98	34·82

Factory Results :—Cane crushed during February . . . . 5,02,596 maunds.
Sugar made during February . . . . 48,054 maunds.
Yield of sugar per cent cane . . . . 9·56 per cent.

Borer Survey :— Yield of sugar from mixed supplies . . . . 9·38 per cent.
Yield of sugar from sound cane . . . . 10·76 per cent.
Yield of sugar from infested cane . . . . 6·98 per cent.

Loss of commercial sugar due to borer infestation 5,02,596 × (10·76—9·38)/100 = 6,936 maunds.

Schedule IV

Ryam Factory

Area	Sound cane						Infested cane						Average yield	Prop. per cent total supplies from area	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Degree of borer and disease on No. of stalks
	No. of stalks	Wt. in seers	Brix	Purity	Sugar per cent	Yield	No. of stalks	Wt. in seers	Brix	Purity	Sugar per cent	Yield						
Cart	393	182	20·02	86·54	13·19	11·12	607	287	15·05	74·77	8·04	6·01	7·99	22·8	1·82	2·54	1·37	60·70
Tramway	488	239	20·54	86·38	13·47	11·39	662	323	15·33	74·46	8·27	6·21	8·41	29·9	2·51	3·41	1·86	57·57
Railway	616	316	20·02	86·44	13·17	11·16	634	294	15·19	75·53	8·33	6·20	8·77	47·3	4·15	5·28	2·93	50·72
Totals and Averages.	1497	737	20·19	86·45	13·27	11·22	1903	904	15·20	74·91	8·22	6·14	...	...	8·48	11·23	6·16	55·97

Factory Results :—Cane crushed during February . . . . 5,10,920 maunds.

Sugar made during February . . . . 44,129 maunds.

Yield of sugar per cent cane . . . . 8·64 per cent.

Borer Survey :— Yield of sugar from mixed supplies . . . . 8·48 per cent.

Yield of sugar from sound cane . . . . 11·23 per cent.

Yield of sugar from infested cane . . . . 6·16 per cent.

Loss of commercial sugar due to borer and disease 5,10,920 × (11·23—8·48)/100 = 14,053 maunds.

SCHEDULE V

Marhowrah Factory

Area	Sound cane: No. of stalks	Sound cane: Wt. in seers	Sound cane: Brix	Sound cane: Purity	Sound cane: Sugar per cent	Sound cane: Yield	Infested cane: No. of stalks	Infested cane: Wt. in seers	Infested cane: Brix	Infested cane: Purity	Infested cane: Sugar per cent	Infested cane: Yield	Average yield	Prop. per cent total supplies from area	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Degree of borer and disease on No. of stalks
Marhowrah .	141	87-2	19·09	85·91	12·96	11·44	109	65-0	16·53	81·32	10·23	8·41	10·14	19·85	2·01	2·27	1·67	44·6
Ramkola .	149	82-12	19·41	85·60	13·14	11·60	151	84-12	16·50	80·05	10·07	8·24	9·89	16·83	1·66	1·95	1·39	50·3
Urna . .	270	152-6	19·66	85·54	13·28	11·71	130	76-2	17·08	81·42	10·59	8·93	10·77	13·89	1·49	1·63	1·24	32·5
Bhatta . .	132	65-8	18·92	86·36	12·91	11·40	118	56-2	16·12	82·14	9·89	8·12	9·88	29·16	2·88	3·32	2·36	47·2
Bankerwa .	160	84-0	19·17	86·61	13·11	11·61	90	44-8	16·24	81·62	9·85	8·09	10·40	15·75	1·64	1·83	1·27	36·0
Paterhi . .	143	69-6	19·26	85·99	13·09	11·59	107	66-9	16·43	80·52	10·02	8·34	9·99	1·52	0·15	0·18	0·12	42·8
Mashrak .	121	55-10	18·23	84·70	12·21	10·71	79	35-14	16·63	81·04	10·26	8·54	9·85	1·36	0·13	0·15	0·12	39·5
Khairah .	169	105-4	19·72	85·58	13·33	11·76	81	38-15	16·12	81·46	9·73	8·01	10·75	1·64	0·18	0·19	0·13	32·3
Totals and Averages.	1285	702-0	19·29	85·78	13·07	11·54	865	467-14	16·50	81·11	10·11	8·36	...	...	10·15	11·52	8·30	40·00

Factory Results :—Cane crushed during February . . . . 6,13,251 maunds.
Commercial sugar made . . . . 61,921 maunds.
Yield of sugar per cent cane . . . . 10·10 per cent.

Borer Survey :— Yield of sugar per cent cane from mixed supplies . . . . 10·15 per cent.
Yield of sugar per cent cane from sound cane . . . . 11·52 per cent.
Yield of sugar per cent cane from infested cane . . . . 8·30 per cent.

Loss of commercial sugar due to borer infestation and disease = 6,13,251 × (11·52—10·15)/100 = 8,401 maunds.

SCHEDULE VI

Purtabpore Factory

Area	Sound cane						Infested cane						Average yield	Prop. per cent total supplies from area	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Degree of borer and disease on No. of stalks
	No. of stalks	Wt. in seers	Brix	Purity	Sugar per cent	Yield	No. of stalks	Wt. in seers	Brix	Purity	Sugar per cent	Yield						
Sirsia . .	1297	558	19·24	86·37	12·63	10·56	715	369	16·34	78·61	9·26	7·05	9·33	32·30	3·01	3·41	2·28	35·54
Gate . .	1085	553	19·11	87·24	12·83	10·73	559	208	16·29	80·23	9·52	7·44	9·68	33·67	3·25	3·61	2·41	34·00
Railway .	1086	526	19·55	86·03	12·79	10·66	576	270	16·70	80·61	9·79	7·66	9·24	5·40	0·50	0·58	0·41	52·27
Mairwa . .	1470	761	19·84	88·66	13·34	11·33	380	183	17·88	83·60	10·97	8·91	10·86	28·63	3·10	3·24	2·55	20·54
Totals and Averages.	4938	2398	19·47	87·22	12·94	10·87	2230	1030	16·70	80·48	9·78	7·65	...	...	9·86	10·84	7·65	31·11

Factory Results :—Cane crushed during February . . . . 5,13,803 maunds.

Sugar made during February . . . . 49,700 maunds.

Yield of sugar per cent cane . . . . 9·67 per cent.

Borer Survey :— Estimated yield from mixed supplies . . . . 9·86 per cent.

Estimated yield from sound cane . . . . 10·84 per cent.

Estimated yield from infested cane . . . . 7·65 per cent.

Loss of sugar due to borer infestation and disease in February 5,13,803 × (10·84—9·86)/100 = 5,035 maunds.

SCHEDULE VII

Tamkohi Factory

Area	Sound cane						Infested cane						Average yield	Prop. per cent total supplies from area	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Degree of borer and disease on No. of stalks
	No. of stalks	Wt. in seers	Brix	Purity	Sugar per cent	Yield	No. of stalks	Wt. in seers	Brix	Purity	Sugar per cent	Yield						
Bubnowlie .	157	66-0	19·89	84·26	13·25	11·10	148	58-7	16·70	77·74	9·91	7·57	9·06	25·1	2·27	2·79	1·90	46·67
Domath .	130	55-4	19·26	85·13	12·96	10·74	120	51-4	17·39	82·40	10·91	8·78	9·80	15·9	1·56	1·71	1·39	48·00
Baikunthpur .	163	68-8	18·37	84·73	12·30	10·14	187	86-11	16·98	80·34	10·41	8·22	9·07	7·9	0·72	0·80	0·65	53·42
Sapaya Farm	98	48-4	19·13	86·88	13·16	11·11	52	27-10	17·24	82·83	10·97	8·96	10·33	2·7	0·28	0·30	0·24	34·66
No. 2 .	92	36-14	18·62	84·99	12·50	10·39	98	34-12	17·36	82·39	10·88	8·75	9·59	8·6	0·82	0·89	0·75	51·58
No. 3 .	103	38-6	18·08	86·03	12·29	10·28	87	38-13	17·13	82·49	10·74	8·65	9·46	8·2	0·78	0·84	0·71	45·79
No. 5 .	116	45-8	19·58	84·23	13·01	10·89	84	31-4	18·23	81·49	11·29	8·98	10·11	13·4	1·35	1·46	1·20	42·00
No. 6 .	126	49-9	19·37	84·17	12·88	10·55	74	32-3	18·17	82·68	11·43	9·22	10·03	9·7	0·97	1·03	0·89	37·00
No. 10 .	91	37-0	19·97	87·75	13·62	11·57	59	22-5	17·46	85·81	11·50	9·56	10·81	8·5	0·92	0·98	0·81	39·00
Totals and Averages.	1076	445-5	19·15	85·21	12·88	10·74	904	383-5	17·29	81·38	10·74	...	...	...	9·67	10·80	8·54	45·66

Factory Results :—Cane crushed during February . . . . . . 5,96,258 maunds.
Sugar made during February . . . . . . 58,537 maunds.
Yield of sugar per cent cane . . . . . . 9·81 per cent.

Borer Survey :— Estimated yield from sound cane . . . . . . 10·80 per cent.
Estimated yield from mixed supplies . . . . . . 9·67 per cent.
Estimated yield from infested cane . . . . . . 8·54 per cent.

Estimated loss of sugar due to borer and disease 5,96,258 × (10·80—9·67)/100 = 6,738 maunds.

SCHEDULE VIII

Gauri Factory

Area	Sound cane						Infested cane						Aver-age yield	Prop. per cent total supplies from area	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Degree of borer and disease on No. of stalks
	No. of stalks	Wt. in seers	Brix	Purity	Sugar per cent	Yield	No. of stalks	Wt. in seers	Brix	Purity	Sugar per cent	Yield						
East-Gate	320	141-14	19·16	86·78	12·79	10·82	80	26-2	16·74	84·36	10·27	8·43	10·45	28·40	2·97	3·07	2·39	20·0
West-Gate	256	121-8	19·16	87·32	12·86	10·93	44	16-8	17·09	84·80	10·48	8·68	10·66	27·23	2·90	2·98	2·36	14·67
Dhara	162	92-8	18·95	86·36	12·37	10·41	38	16-8	16·86	84·13	10·25	8·23	10·08	15·24	1·54	1·59	1·25	19·00
Hetimpur	245	127-8	18·93	87·13	12·48	10·56	55	20-8	17·04	84·51	10·41	8·39	10·26	5·15	0·53	0·54	0·43	18·67
Motipokar	251	119-0	19·04	87·55	12·62	10·72	49	24-0	17·33	84·59	10·61	8·77	10·39	2·93	0·30	0·31	0·26	16·33
Jugalganj	251	120-8	19·26	87·47	12·75	10·83	49	21-8	17·30	84·42	10·57	8·73	10·51	7·49	0·79	0·81	0·65	16·33
Bakra	249	114-8	19·35	87·25	12·78	10·83	51	21-8	17·38	84·97	10·69	8·80	10·51	9·47	1·00	0·98	0·83	17·00
Tramway	244	124-8	19·33	87·65	12·79	10·90	56	21-8	16·24	84·70	9·93	8·21	10·50	1·73	0·18	0·19	0·14	18·67
Rudrapur	254	137-0	19·86	87·91	13·24	11·28	46	19-0	17·76	85·26	10·98	9·14	11·02	2·36	0·26	0·27	0·21	15·33
Totals and Averages.	2232	1098-14	19·24	87·29	12·76	10·83	468	187-2	18·04	84·63	10·46	8·60	...	...	10·47	10·74	8·52	17·33

Factory Results :—Cane crushed during February . . . . 4,28,518 maunds.
Sugar made during February . . . . 45,543 maunds.
Yield of sugar per cent cane . . . . 10·63 per cent.

Borer Survey :— Estimated yield from mixed cane . . . . 10·47 per cent.
Estimated yield from sound cane . . . . 10·74 per cent.
Estimated yield from infested cane . . . . 8·52 per cent.

Loss of sugar due to borer and disease 4,28,518 × (10·74—10·47)/100 = 1,157 maunds.

SCHEDLE IX

Balrampur Factory

Area	Sound cane						Infested cane						Aver-age yield	Prop. per cent total supplies from area	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Degree of borer and disease on No. of stalks
	No. of stalks	Wt. in seers	Brix	Purity	Sugar per cent	Yield	No. of stalks	Wt. in seers	Brix	Purity	Sugar per cent	Yield						
Kauria . .	118	68-12	19·72	89·92	14·01	12·04	32	13-4	15·93	86·49	10·89	9·09	11·56	5·15	0·60	0·62	0·47	21·33
Circle No. 3 .	117	87-0	18·80	89·45	13·29	11·38	33	22-0	17·57	85 22	11·33	9·80	11·06	3 98	0·44	0·45	0·39	22·00
No. 4 .	144	113-4	18·43	89·69	13·06	11·08	56	37-0	14·35	84·32	9·56	7·83	10·28	8·90	0·91	0·99	0·70	28·00
No. 5 .	114	71-8	18·98	88·02	13·19	11·18	36	22-12	14·31	81·58	9·22	7·55	10·30	17·41	1·79	1·95	1·31	24·00
No. 6 .	158	99-0	19·28	90·22	13·74	11·81	42	26-4	15·27	83·63	10·09	8·19	11·05	10·57	1·17	1·25	0·87	21·00
No. 13 .	69	46-0	19·85	89·76	14·07	12·08	31	19-12	15 29	83·74	10·11	8·25	10·93	5·79	0·63	0·70	0·48	31·00
Sriganj . .	115	66-12	19·75	91·11	14·21	12·21	35	16-12	16·00	84·66	10·67	8·74	11·51	5·00	0·58	0·61	0·44	23·34
Kawapur .	150	110-0	18·52	87·42	12·79	11·00	50	34-0	14·26	84·13	9·49	7·70	10·22	15·73	1·61	1·73	1·21	25·00
Inthiathoke .	154	96-8	18·61	89·64	13·18	11·33	46	27-12	14·89	84·01	9·88	8·02	10·59	16·56	1·75	1·88	1·33	23·00
*Gonda . .	224	133-8	18·19	89·80	12·90	11·08	76	42-12	15·67	84·20	10·42	8·53	10·46	10·91	1·14	1·21	0·93	25·33
Totals and Averages.	1363	892-4	18·87	89·45	13·34	11·43	437	262-4	15·23	84·10	10·12	...	...	...	10·62	11·39	8·13	24·28

Factory Results :—Cane crushed during February . . . . 5,04,128 maunds.
Sugar made during February . . . . 52,855 maunds.
Yield of sugar per cent cane . . . . 10·49 per cent.

Borer Survey :—
Estimated yield from mixed cane . . . . 10·62 per cent.
Estimated yield from sound cane . . . . 11·39 per cent.
Estimated yield from infested cane . . . . 8·13 per cent.

Loss of sugar due to borer and disease = 5,04,128 × (11·39—10·62)/100 = 3,882 maunds.

SCHEDULE X

Tulsipur Factory

Area	Sound cane						Infested cane						Average yield	Prop. per cent total supplies from area	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Degree of borer and disease on No. of stalks
	No. of stalks	Wt. in seers	Brix	Purity	Sugar per cent	Yield	No. of stalks	Wt. in seers	Brix	Purity	Sugar per cent	Yield						
Gaimsari .	541	333-0	19·88	85·90	12·94	10·84	180	100-0	18·61	84·15	11·37	9·49	10·53	26·01	2·74	2·82	2·46	24·97
Pachperwa .	565	297-10	20·00	86·10	13·04	10·95	228	122-8	18·92	84·58	11·63	9·53	10·54	30·92	3·26	3·39	2·95	28·75
Tulsipur .	341	203-2	19·61	86·02	12·77	10·72	104	61-9	18·62	83·99	11·36	9·31	10·39	23·40	2·43	2·51	2·18	23·37
Pipra . .	212	153-1	19·54	85·64	12·69	10·58	59	30-15	17·91	83·99	10·90	8·92	10·30	12·10	1·25	1·28	1·08	21·77
Bankatwa .	153	109-8	20·03	86·03	13·02	10·88	35	24-15	18·63	83·88	11·34	9·24	10·58	4·00	0·42	0·44	0·37	18·62
Jarwa . .	85	52-12	20·12	86·15	13·14	10·94	70	36-4	19·24	82·72	11·56	9·26	10·26	3·57	0·37	0·39	0·33	45·16
Totals and Averages.	1897	1149-1	19·84	85·96	12·92	10·82	676	376-3	18·72	84·09	11·43	9·39	...	...	10·47	10·83	9·37	26·27

Factory Results :—Cane crushed during February . . . . 4,74,309 maunds.

Sugar made during February . . . . 49,824 maunds.

Yield of sugar per cent cane . . . . 10·50 per cent.

Borer Survey :— Estimated yield from mixed supplies . . . . 10·47 per cent.

Estimated yield from sound cane . . . . 10·83 per cent.

Estimated yield from infested cane . . . . 9·37 per cent.

Loss of sugar during February due to borer and disease 4,74,309 × (10·83—10·47)/100 = 1,708 maunds.

SCHEDULE XI

Results of a borer infestation survey in February 1937

—	Factories situated in North Bihar					Factories situated in Eastern United Provinces					Totals and Averages
	Chanpatia	Barrah	Samastipur	Ryam	Marhowrah	Purtabpore	Tamkohi	Gauri Bazar	Balrampur	Tulsipur	
Number of stalks examined	5,300	8,500	4,500	3,400	2,150	7,168	1,980	2,700	1,800	2,573	40,071
Number of sound stalks	2,720	5,559	2,933	1,497	1,285	4,938	1,076	2,232	1,363	1,897	25,500
Number of infested stalks	2,580	2,941	1,567	1,903	865	2,230	904	468	437	676	14,571
Per cent infestation	48·68	34·60	34·80	55·97	40·00	31·11	45·66	17·33	24·28	26·27	36·36
Total weight of cane (seers)	2,139	2,835	1,884	1,641	1,170	3,428	828	1,286	1,154	1,525	17,890
Weight of sound cane (seers)	1,059	1,852	1,227	737	702	2,398	445	1,099	892	1,149	11,560
Weight of infested cane (seers)	1,080	983	657	904	468	1,030	383	187	262	376	6,330
Weight of 1000 stalks sound cane (seers).	389	331	418	493	546	486	414	492	654	605	453
Weight of 1000 stalks infested cane (seers).	418	334	419	475	540	461	423	400	599	556	434
Brix of extracted juice, sound cane	19·42	19·35	19·45	20·19	10·29	19·47	19·15	19·24	18·87	19·84	19·43
Brix of extracted juice, infested cane	17·91	16·97	16·21	15·20	16·50	16·70	17·29	18·04	15·23	18·72	16·88
Purity of extracted juice, sound cane	86·34	83·59	86·77	86·45	85·78	87·22	87·75	87·29	89·45	85·96	86·66
Purity of extracted juice, infested cane	81·08	78 35	78·94	74·91	81·11	80·48	81·38	84·63	84·10	84·09	80·91
Sugar per cent sound cane	13·23	12·68	12·76	13·27	13·07	12·94	12·88	12·76	13·34	12·92	12·99
Sugar per cent infested cane	10·84	10·12	9 23	8·22	10·11	9·78	10·74	10·46	10·12	11·43	10·11
Yield per cent from sound cane	11·27	10·57	10·76	11·23	11·52	10·84	10·84	10·74	11·39	10·83	11·01
Yield per cent from infested cane	8·96	8·05	6·98	6·16	8·30	7·65	8·56	8·60	8·13	9·37	8·08
Average yield per cent on total cane	10·13	9·76	9·38	8·48	10·15	9·86	9·67	10·47	10·62	10·47	9·89
Actual factory yield for February	10·05	9·68	9·56	8·64	10·10	9·67	9·81	10·63	10·49	10·50	9·91
Mds. cane crushed in February	5,88,537	5,85,136	5,02,596	5,10,920	6,13,251	5,13,803	5,96,258	4,28,518	5,04,128	4,74,309	53,17,456
Mds. sugar lost due to infested cane	6,709	4,740	6,936	14,053	8,401	5,035	6,738	1,157	3,882	1,708	59,359

FURTHER WORK ON THE MANURING OF SUGARCANE IN NORTH BIHAR

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Introduction

It is now generally well known that in North Bihar and in the United Provinces the number of factories for the production of sugar direct from sugarcane has very greatly increased, and the area on which the crop is grown has spread to comparatively large figures ; so that the production of white sugar in north-east India has now approached the stage of supplying almost the total consumption of India. In recent years also, world conditions generally and competition among the Indian factories themselves to market their sugar, have both tended to depress the prices obtainable for Indian produced sugar. There is no doubt that prices for cane are still relatively high compared with those at which the crop can be produced in other countries. To establish a sound sugar industry in India total production costs must be brought nearer to those of other countries and an important item in the reduction of costs that will be necessary must be a generally lower price for cane. This will involve a revision of our calculations as to sound expenditure on the cultivation of the crop. We have worked so far on a basis of annas 4 or 4½ per maund on the field, but I think in future we must consider this basis to be annas 3½ or even 3. This consideration makes it exceedingly important that our recommendations with regard to the manuring of sugarcane should be kept in the cheapest possible form, and that, although actually even at the lower price under consideration it will still pay handsomely to use the relatively high-priced artificial manures with judgment and care on well-organised and extensive cane-growing concerns, for the smaller, less-organised growers it is wise to keep our recommendations as near as possible to manures they can obtain relatively cheaply or grow at comparatively low cost. Another consideration bearing in the same direction is that we all realise more and more the enormous value of humus to the cultivated soils of India, particularly to those on which sugarcane is grown under un-irrigated or semi-irrigated conditions. The writer has, therefore, collected together, from the results of manurial trials on cane on the farms under his control until last year, the following figures indicating the value of a small dressing of superphosphate in conjunction with both farmyard manure and green manuring.

The effects on the sugarcane crop of artificial manures containing varying proportions of nitrogen and phosphoric acid (P_2O_5) have been discussed [Cliff, 1931] and the conclusion was reached that the cane crop of North Bihar required generally, and in all cases made a handsome profit on, a dressing containing forty lbs. nitrogen and fifty lbs. phosphoric acid per acre. For the last few years, work has been proceeding to endeavour to determine whether the commonly obtainable and comparatively cheap organic manures, mainly farmyard manure and *sanai* green manure, provide that balanced dressing, or whether an addition of phosphoric acid to these manures was required and was profitable, and also whether, in view of the limited quantities of these manures available and commonly applied, an additional dressing of nitrogen and phosphoric acid applied at earthing time was generally profitable or not.

Conditions of experiment

All sugarcane growers tend to use for their cane land whatever farmyard manure is available, and of recent years a very large number of them have adopted a system of growing *sanai* for the green-manuring of cane ; but the smaller cultivators, whose resources are limited, have small supplies of farmyard manure, generally of poor quality, available for the purpose, and if they grow green manure, generally succeed in producing a very light crop only. On our Government farms in North Bihar, particular care is taken in the storage of farmyard manure ; and at Sepaya, where rather more than half of our cattle-dung comes from the dairy herd, the quality of the finished product is relatively high, although on our other farms where only working bullocks are kept, both the quantity available and its quality are lower. Even on those farms we are in a better position in this respect than the smaller cultivators. Moreover, our standard of cultivation is such that our green manure crops are good and represent, therefore, both in bulk and nitrogen content the total requirements of a good cane crop. It is difficult for us, therefore, to work out on our farms, trials that are strictly comparable with the conditions of the holdings of the poorer, smaller cane-growers ; and our results, therefore, apply completely only to the larger holdings of better-cultivated land, and their application to general cultivation requires further consideration.

Details of experiments

Having established by the end of 1931 that cane in North Bihar requires and pays handsomely for, forty lbs. nitrogen and fifty lbs. phosphoric acid per acre, we have since that date used in our sugarcane manurial trials basic dressings alternatively of farmyard manure and *sanai* green manure. The results of numerous previous analyses studied, and of examinations of samples drawn from our own stocks, indicate that the nitrogen content of farmyard manure as generally available ranges from about 0·35 to 0·5 per cent, the higher figures being

obtained from well-stored manure derived from well-fed cattle. The corresponding figures for the phosphoric acid content are 0·2 to 0·35 per cent ; and from what analyses are available, it seems clear that the proportion of phosphoric acid in farmyard manure is too low to make a balanced dressing for sugarcane in North Bihar. As regards *sanai* green manure, we have been working on the figures given by Clark for the United Provinces as to the amount of nitrogen returned per acre by the ploughing in of a heavy crop of green manure. Our programme has, therefore, been to add to the basic dressing of farmyard manure or green manure, firstly, a small dressing of superphosphate calculated to give an additional thirty lbs. of phosphoric acid per acre, and secondly in addition to this, a top dressing of twenty lbs. nitrogen and 25 lbs. phosphoric acid per acre at earthing time. In addition, we have included wherever possible in our trials a series of plots receiving no organic manure, but fertilized with artificials giving forty lbs. nitrogen and fifty lbs. phosphoric acid per acre in two doses, one at planting and one at earthing. When the trials were started we were still scattering our plots in regular order A B C D, A B C D, etc., and treating the results statistically by Engledow and Yule's Shorter Students' method. By 1933-34, however, we had got some of our staff trained to the randomised block lay-out, and the treatment of the results according to Fisher's method. But it was not possible, until comparatively recently, to get this randomised block system adopted on all our farms. In the Appendix, therefore, the method of lay-out and statistical treatment have been indicated clearly for the different farms in the different areas in which the results were obtained. Two factors have emerged which have made the attainment of clear-cut results more than usually difficult. One is that at Sepaya the cattle manure, being largely from a highly-fed dairy herd and very carefully handled and conserved, is much richer than manures met with in common practice, and therefore the ordinary dressing of one cartload per *cottah* or approximately 270 maunds per acre, seems to contain not only more than sufficient nitrogen for the cane crop, but also ample phosphoric acid. Secondly, in the cases of some farms where the standard of scientific management is not so high and facilities for central control not so easy, it has been found that the randomised block system does, in a comparatively large number of cases, not give the clear differences in response to different treatments that were obtained from the older method. Of the twenty-five trials actually laid down, for these reasons five have failed to show any significant differences, and their results have, therefore, been omitted from the table of results presented.

Consideration of detailed results

To consider the results for the trials based on farmyard manure first we find that at Sepaya, where the farmyard manure is rich, the small dressing of two maunds per acre of superphosphate generally failed to give any statistically significant increase of crop. On the other farms, however, where the quality

of the farmyard manure more nearly approximates to that in common use in North Bihar, the small dressing of superphosphate has given a significant increase ranging from fifty maunds of cane per acre to something like 200. In only relatively few cases, however, has a further dressing of twenty lbs. nitrogen and twenty-five lbs. phosphoric acid per acre given a further increase of crop. In the cases, as at Sepaya, where plots have been included in the series receiving only artificial manures, a dressing of forty lbs. nitrogen and fifty lbs. phosphoric acid per acre applied in this way has given practically the same crop as farmyard manure plus the extra dressing of the superphosphate.

In the green manure series, however, in every case the addition of two maunds per acre of superphosphate has given an increase of crop statistically significant and more than sufficient to pay a sound profit on the cost of the superphosphate. In many cases in this series also, the top dressing of twenty lbs. nitrogen and twenty-five lbs. phosphoric acid per acre has given a further significant increase and has been distinctly profitable. In this series also, where it has been possible to include plots dressed with artificials only, the dressing of artificials calculated to give forty lbs. nitrogen and fifty lbs. phosphoric acid per acre has given almost exactly the same crop as green manure plus the small dressing of superphosphate.

Discussion of results

From the results of these trials, we are, therefore, justified in carrying our recommendations on the manuring of the sugarcane crop in North Bihar a stage further. It is further confirmed that the sugarcane crop in North Bihar requires and pays handsomely for a dressing containing forty lbs. nitrogen and fifty lbs. phosphoric acid per acre ; and, where organic manures such as cattle manure or green manure are not available, it is entirely sound to use for the purpose $3\frac{1}{2}$ maunds of Niciphos II per acre, the cost of this dressing being approximately Rs. 22 only. If, however, farmyard manure is available the applications required depend on the quantity and quality of the manure that can be applied. Where really good well-preserved manure can be applied at the rate of ten tons or 270 maunds per acre, which is equivalent to one cart-load per *cottah*, this dressing is just about sufficient in phosphoric acid content, and rather more than sufficient in nitrogen content. Where, however, as on big estates and the holdings of the larger cultivators the quality of the manure available, though better than that used by the smaller cultivator, is still average only, this manure should be used at the above rate for as much land as it will cover, but the land to which it is applied should also be given a dressing of two maunds per acre single superphosphate or one maund per acre double superphosphate, and this superphosphate should be applied to the land in the furrows at the time of planting the cane. Where the quantity of manure available does not allow for the full dressing indicated above to be given, it will pay handsomely to supplement the farmyard manure with a top dressing applied at the time of earthing the cane, of

$1\frac{1}{2}$ maunds per acre of Niciphos II containing twenty-five lbs. phosphoric acid and twenty-five lbs. nitrogen per acre and costing Rs. 11 or 12 only.

In the case of large estates and the holdings of larger cultivators who can spare land from food crops for green manure for their cane crop, such land should be green manured with *sanai* grown in the monsoon previous to the planting of the cane. Where the land is green manured it will pay handsomely to give in addition a dressing of two maunds per acre single superphosphate or one maund per acre double, in the furrows at the time of planting the cane. Where the green manure crop for some reason, such as a bad season or poor cultivation, is not a good one; that is to say if the *sanai* at the time of ploughing in is a thin plant less than two feet high, in addition to the superphosphate applied at planting time the sugarcane should be given at earthing time a top dressing of $1\frac{1}{2}$ maunds of Niciphos II per acre.

Conclusion

To assist in establishing the Indian sugar industry on a sound basis the price of cane must be lowered. The cane crop occupies the ground for such long periods, its cultivation extends from eighteen months to two years, and the proportion of its total growing costs involved in rent and actual cultivation charges are so great, that the soundest way to cheapen the cost of production so as to leave a sound profit even at the lower prices expected, is to reduce the area under cane and concentrate on getting from that area a heavy yield of good quality sugarcane. To do this, adequate manuring is as important as—if not more important than—thorough cultivation. The use, to the greatest extent possible, of the available supplies of farmyard manure or, alternatively, green manuring the land thoroughly for cane, is the soundest and most economical basis of sugarcane manuring on these soils and in this climate; but to get the best value for the cane crop out of the farmyard manure applied or the green manure grown, the addition of two maunds per acre single, or one maund per acre double superphosphate, at planting is almost invariably necessary and its application exceedingly profitable. Where the farmyard manure supplies are too small for the area of land it is desired to cover, or the quality of the manure likely to be low, a further top dressing of $1\frac{1}{2}$ maunds per acre Niciphos II is very wise and exceedingly profitable.

The sound response to lower prices for cane is not, as is so generally preached, a lowering of the standard of cultivation, but is rather a reduction of the area planted and an intensification of the cultivation of that area. The cheapest and soundest intensification possible to most cane-growers is the wise utilisation of their available supplies of farmyard manure or the growth of green manure, the supplementing of these by the addition of the small amounts of superphosphate recommended, and if necessary, the use of the small and cheap top dressing

indicated. It is better for the cultivator and for the mill to grow 600 maunds of cane on one acre of land than to grow 200 maunds per acre on three acres; to cultivate three acres even badly, the cultivator's costs will be far higher, while the mill will not thank him for three acres of light, diseased cane. Six hundred maunds from one acre means a strong, healthy, solid crop, cheap to produce and eagerly accepted by the mills.

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Crop	History, object and scheme	Rotation	No. of replications and size of plots	Designation	Method of scatter and treatments: Manures applied per acre in lbs. At planting N	At planting P_2O_5	At earthing N	At earthing P_2O_5	Mean yield per plot In lbs.	Mean yield per plot In Mds.	Average yield per acre In lbs.	Average yield per acre In Mds.	Percentage of general mean	Analysis of variance: Method	Due to	Degrees of freedom	Sum of the squares of deviations	Mean squares	Standard error	Error of difference	$\frac{1}{2}\log_e$ mean squares	Difference of $\frac{1}{2}\log_e$ mean squares	z value when $p=0\cdot05$	Significance of the experiment	Treatments compared	Mean differences Md.	Critical difference $Ed\times t$	Significance of the difference
Sugarcane farmyard manure series.	So far 40 lbs. N and 50 lbs. P_2O_5 per acre considered as economically the most suitable dressing. Confirmation necessary.	Fallow in the previous *rabi* (F. Y. M. applied)	6 2 ch. × 9 ft. = 0·027 acre		Scattered in order						*Sepaya Farm*			*1932-33.* Engledow and Yule														
				A	F	Y.	M.			19·7		722·3	93·4												AB	1·4	1·2	Sig.
				B	F. .	Y 30	M. .	+ ...		21·1		773·7	100·0							0·59					AC	1·8		Do.
				C	F ..	Y 30	M. 20	+ 25		21·5		788·3	101·9												AD	2·4		Do.
				D	20	25	20	25		22·1		810·3	104·7												BC	0·4		Insig.
					General mean					21·1			100												BD	1·0		Do.
															B, C, D>A										CD	0·6		Do.
Do. G. M. series	Ditto	Fallow in the previous *rabi*. G. M in the previous monsoon	Do.		Scattered in order									Do.														
				A	G.	M				19·4		711·3	92·4												AB	1·2	0·9	Sig.
				B	G. ...	M. 30	+ ..	 ...		20·6		755·3	98·1							0·44					AC	3·2		Do.
				C	G. ...	M. 30	+ 20	 25		22 6		828·7	107·6												AD	2·0		Do.
				D	20	25	20	25		21·4		784·7	101·9												BC	2·0		Do.
					General mean					21·0			100												BD	0·8		Insig.
															C>B=D>A										CD	1·2		Sig.
Sugarcane	So far 60 lbs N and 75 lbs. P_2O_5 per acre found to be the best dressing. Confirmation necessary	Do.	Do.		In order						*Sewan Farm*			*1932-33.* Do.														
				A	F.	Y.	M.			7·5		275·0	83·7												AB	1·5	0·8	Sig.
				B	F. .	Y 30	M. ...	+ ...		9 0		330·0	100·0												AC	1·9		Do.
				C	F. ...	Y. 30	M. 20	+ 25		9·4		344·7	104·8												AD	2·5		Do.
				D	F. 20	Y. 25	M. 20	+ 25		10·0		366·7	111·5							0·39					BC	0·4		Insig.
					General mean					9·0			100												BD	1·0		Sig.
															B, C, D>A; D>B.										CD	0·6		Insig.
Sugarcane	So far 40 lbs. N and 50 lbs P_2O_5 per acre the best dressing. Further inquiry based on F. Y. M. (as at Sewan)	Do.	Do.		In order						*Darbhanga Farm*			*1932-33.* Do.														
				A	F.	Y.	M.			15·6		572	89·4												AB	1·1	2·0	Insig.
				B	F. ..	Y. 30	M. ...	+ ...		16·7		612	95·7												AC	2·1		Sig.
				C	F. ...	Y. 30	M. 20	+ 25		17·7		649	101·4							0·95					AD	4·2		Do.
				D	F. 20	Y. 25	M. 20	+ 25		19·8		726	113·5												BC	1·0		Insig.
					General mean					17·45			100												BD	3·1		Sig.
															D>B, C & A; C>A										CD	2·1		Do.
Sugarcane farmyard manure series (as f Sepaya)	So far 40 lbs. N and 50 lbs. P_2O_5 per acre the best dressing. Confirmation necessary on the basis of F. Y. M.	Do.	Do.		In the order						*Byreah Farm*			*1932-33* Do.														
				A	F.	Y.	M.			16·7		592	90·1												AB	1·4	1·4	Sig.
				B	F. ...	Y. 30	M ...	+ ...		18·1		662	97·7												AC	3·1		Do.
				C	F. ...	Y. 30	M. 20	+ 25		19·8		725	106·9							0·68					AD	2·8		Do.
				D	20	25	20	25		19·5		715	105·3												BC	1·7		Do.
					General mean					18·5			100		C=D>B>A										BD	1·4		Do.
																									CD	0·3		Insig.

Crop	History, object and scheme	Rotation	No. of replications and size of plots	Designation	Manures applied per acre in lbs. At planting N	At planting P_2O_5	At earthing N	At earthing P_2O_5	Mean yield per plot In lbs.	Mean yield per plot In Mds.	Average yield per acre In lbs.	Average yield per acre In Mds.	Percentage of general mean	Method
					Method of scatter and treatments									
Sugarcane *sanai* series	Up to 1931-32, 40 : 50 best dressing 1932-33 60 : 75 (G. M. + artificial) and 40 : 50 equally best dressing	Fallow in the previous *rabi*. G. M. in the previous monsoon	8 2 ch. × 3 yds = 3/110 acre = 0·027 acre		In the order						*Byreah Farm 1933-34*			
				A	G. M.				1,246·4	15·2	45,701	557·3	81·4	Engledow and Yule
				B	G. M. + ...	30	...	...	1,549·8	18·9	56,826	693·0	101·6	
				C	G. M. + ...	30	20	25	1,689·2	20·6	61,937	755·3	110·6	
				D	20	25	20	25	1,623·6	19·8	59,532	726·0	106·3	
					General mean				1,525·2	18·6	55,924		100	
Sugarcane CO 213. G. M. series	1926-27, importance of P_2O_5 known. 1927-28, this was confirmed. 1928-29— 40 : 50 } promising. 40 : 100 } 1929-30, early application of P_2O_5 of advantage 1930-31— 40 : 50 44% > no manure. 40 . 100 47% > no manure. 1931-32— 40 : 50 16% > no manure. 40 : 100 15% > no manure. 80 : 100 27% > no manure. 1932-33— G. M. + 8 6% > G. M. (40 : 50). (40 : 20) Do. + 20 : 25 17% > Do. (60 : 75) No. G. M. + 40 : 50 10% > Do. Best dressing G. M. + 0 : 30 + 20 : 25, 1933-34 experiment of this series was also insignificant	Fallow in the previous *rabi*. (G. M. in the previous monsoon)	6 165 lks × 9 ft. = 0 0225 acre = 9/400 acre		Randomised blocks						*Sepaya Farm 1934-35.*			
				A	G. M.				1,371·3	16·66	60,947	740·7	90·4	Fisher and Wishart
				B	G. M. + ...	30	...	...	1,540·5	18·71	68,467	832·1	101·5	
				C	G. M. + ...	30	20	25	1,601·5	19·45	71,178	865·1	105·6	
				D	20	25	20	25	1,555·5	18·90	69,113	840·2	102·5	
					General mean				1,517·2	18·42	67,481		100	
Sugarcane. Co. 210	1928-29, 40 : 50 best dressing 1929-30, 40 : 50 best dressing 1930-31, economic dose between 40 : 50 and 60 : 100 1931-32, 60 : 75 best dressing 1932-33 80 : 100 best dressing but it was not significantly better than 60 : 75 and the latter not significantly better than 40 : 50 1933-34, 80 : 100 best dressing but this was not significantly better than 40 : 50 and the latter not significantly better than 60 : 75	Fallow in the previous *rabi*. G. M. in the previous monsoon. (F. Y. M. applied)	8. 2 ch. × 9 ft. = 3/110 acre = 0·027 acres		Randomised blocks						*Sewan Farm 1934-35.*			
				A	F. Y. M.					16·95		621·5	85·9	Do.
				B	F. Y. M. + ...	30	...	...		20·07		736·1	101·7	
				C	F. Y. M. + ...	30	20	25		20·98		769·1	106·3	
				D	F. Y. M. + 20	25	20	25		20·95		768·2	106·1	
					General mean					19·74			100	

Analysis of variance

Crop	Due to	Degrees of freedom	Sum of the squares of deviations	Mean squares	Standard error	Error of difference	½ $\log_e$ mean squares	Difference of ½ $\log_e$ mean squares	z value when $p = 0·05$	Significance of the experiment	Treatments compared	Mean differences Md.	Critical difference $Ed \times t$	Significance of the difference
Sugarcane *sanai* series	Blocks										AB	303·4	144·65	Sig.
	Treatments										AC	442·8		Do.
	Error				194·34	68·88					AD	377·2		Do.
	Total										BC	139·4		Insig.
	P. C. E.										BD	73·8		Do.
											CD	65·6		Do.
	B, C, & D > A. Additions of artificial manures are significantly better than G. M.													
Sugarcane CO 213. G. M. series	Blocks	5	36,812	7,362	181·8 for total 30·3 for mean		4·45				AB	160·2	91·2	Sig.
	Treatments	3	182,360	60,787		42·8	5·51	T—E			AC	230·2		Do.
	Error	15	82,656	5,510			4·31	1·20	0·6250	Sig.	AD	184·2		Do.
	Total	23	301,828								BC	61·0		Insig.
	P. C. E.				2·00						BD	15·0		Do.
	B, C, D > A.										CD	46·0		Do.
Sugarcane. Co. 210	Blocks	7	201,352		196·4 for total 24·3 for mean						AB	125	71	Sig.
	Treatments	3	140,869	46,956		34·26	1·924	T—E			AC	161		Do.
	Error	21	101,237	4,821			0·786	1·138	0·6250	Sig.	AD	160		Do.
	Total	31	443,458								BC	36		Insig.
	P. C. E.				3·1						BD	35		Do.
	B, C, D > A.										CD	1		Do.

NOTES

NEED FOR A SOIL SURVEY OF INDIA

A JOINT discussion by the Sections of Agriculture and Geology was held during the Science Congress week at Hyderabad (Deccan), on the "Need for a Soil Survey of India".

Rao Bahadur B. Viswa Nath, the President of the Agricultural Section, presided.

Sir John Russell, F. R. S., Director, Rothamsted Experiment Station, was present throughout the discussion and took part in it.

The President, Mr. B. Viswa Nath, opening the discussion, observed as follows .—

" I count it a piece of singular good fortune that it has been possible for Sir John Russell to be present this morning when this important subject is being discussed, in spite of his several engagements and the pressing demands on his time. I realise that Sir John is still touring the country and he cannot, therefore, be expected to give his fully considered views on the subject, but we will be grateful if Sir John will make a few observations based on his wide experience of similar problems in other parts of the world and on what he has already seen in India."

" The subject under discussion is the " Need for a Soil Survey of India ". The answer to such a general question will undoubtedly be in the affirmative ; but the point for consideration is the type of survey. In arriving at an answer to this question it will be necessary :—

(*i*) to consider the objects of the soil-survey,

(*ii*) to ascertain what has already been done in India and what is being done, and

(*iii*) to define what is wanted to be done.

A soil survey can be carried out for one or more of many purposes. It can be carried out for settling new land. It can be carried out for ascertaining the physical and chemical characteristics of the soil with reference to manurial treatment, and irrigation projects.

There are in India about 150 million acres of waste land which may be brought under cultivation. All this land is, however, not situated in one compact block

but is scattered in patches all over India. It is necessary, therefore, in the first instance, to ascertain the nature and the disposition of the waste land and this would perhaps form a subject of enquiry in the provinces.

During the past quarter of a century soil-surveys have been in progress in the different parts of the country to ascertain the manurial and fertilizer requirements of the soils. As a result, a considerable amount of valuable data have been collected and these are being used in advising on manurial programmes and farming projects. In recent years enquiries have been commenced in connection with irrigation and drainage problems with a view to the suitability of the soils for irrigation and to ascertain the most suitable alignment for irrigation and drainage channels.

There remains, therefore, the survey for the classification of soils so that the information obtained will throw light on their formative processes and characteristics and be useful in interpreting the response to manurial treatments and for research and advisory work. We have, therefore, to consider what methods of survey are needed for this purpose.

In England the basis of classification in the early days was geological, the assumption being that each geological variation gave rise to its own type of soil. Subsequently this was not found to answer the purpose. The effect of climate, altitude, topography and other factors was considerable, and soils formed from the same geological parent material varied appreciably. Then, there are the Russian and American methods of classification which are chiefly based on the study of the soil profile.

The soils of India can be very broadly classified into the Indo-Gangetic alluvium covering about 300,000 sq. miles ; the tract of black soils extending to a total area of about 200,000 sq. miles, and a red soil tract including laterite soils, of 150,000 sq. miles. The black soils, although derived from different basic materials, possess common agricultural characteristics and characteristic silica-alumina ratio varying within narrow limits. The large tract of Indo-Gangetic alluvium is, as its name implies, mostly almost alluvial in nature. The soil profile in this case does not appear to be so important as it is elsewhere, but surely it should be possible to differentiate profiles even in this huge block of alluvium with reference to the relative intensities of rainfall, evaporation and temperature. The ratio of rainfall to temperature for the different parts of India varies from 0·10 to 1·5. A broad classification of areas may be made into :

North-East India,

North-West India,

North Central Alluvial India, and

Peninsular India,

which again, can be sub-divided on the ratio basis and classified with respect to texture and composition.

Mr. Wadia and Mr. Roy of the Geological Survey of India discussed the importance of soil formation from the geological point of view. They emphasised the value of geological data to the soil-survey, particularly in relation to the nature of subsoil water. Mr. H. C. Champion of the Forest Research Institute, discussed the economic importance of changes in plant cover and gave expression to the fear that a soil recognized as suitable for some particular agricultural crop would be deforested for agricultural purposes without sufficient consideration of the protective and water-storage factors by the natural plant cover. Mr. Wad, Rao Sahib Bal and Dr. Kashinath spoke with reference to the soils in their respective provinces. Dr. Puri discussed the means of approaching the problem and the methods to be employed for the survey. He suggested that a committee of chemists who have had experience in soil-survey work should meet and co-ordinate the results of the survey."

Sir John Russell's Speech

Sir John Russell then spoke as follows :—

President, Ladies and Gentlemen,

First of all, may I say how glad I am to be able to be here and how much I regret my inability to give an address this afternoon as desired by the President and the workers here. Unfortunately my programme has already been filled. Further, in my remarks this morning I must confine myself to certain general statements; as your President has pointed out, my journey throughout India is not yet completed and obviously at this stage I cannot be expected to put forward any final views. But already certain important points have emerged and these I can put before you.

I am not yet prepared to express any views as to the need of a soil-survey. One's first instinct is to say that a survey is certainly needed, but the Royal Commission thought otherwise, and their recommendations and opinions are in general so sound that one has to be sure of one's ground before disagreeing. Perhaps during the past ten years the situtation has sufficiently altered to justify a survey. On this point I express no opinion. I do not today propose to discuss this, but shall confine myself to indicating various directions in which local surveys can profitably be made.

In regard to the cultivable wastes of 150 million acres mentioned by Mr. Viswa Nath, one cannot help feeling that there is a good deal of it that could even in present conditions be brought into cultivation, and one advantage of a survey will undoubtedly be that it will enable us to ascertain which are the most promising areas for reclamation,

In regard to manurial experiments a good deal of information had already been obtained and this will be extended now that modern methods are so widely being used. It is, however, impossible to utilize fully the results of manurial experiments unless the soils are properly examined and characterised. A soil-survey in relation to the area served by the experimental station affords an effective method of showing how far the experimental results are likely to be applicable in practice.

Further, there is the problem of irrigation to which Rao Bahadur Viswa Nath has referred. I attach great importance to making a proper survey of any region that it is proposed to irrigate. In the past it has often happened, both in India and in other countries, that engineers have completed the irrigation project and delivered water on to the soil first without ascertaining what will happen when it gets there. Several expensive schemes have ended in failure and in the meantime the agriculturist has had to bear the burden. Trouble from water-logging is likely to follow irrigation unless the scheme has been planned as guided by a previous soil-survey. I could give instances from different parts of the world which I have visited where the scheme considered from the engineering point of view has been admirable, but from the soil point of view it was bad. A preliminary soil-survey is invaluable for indicating what part of the area can, with advantage, be watered and what part should not.

Coming now to the important problem of classification, several methods have been used. The earliest was textural : soils were classified as sands, loams, clays, etc. This was useful but insufficient. Then came the geological basis ; then climatic; then the profile basis. All are useful, but objection can be taken to all of them. Mr. Wadia referred to the geological basis of classification. The difficulties in regard to this arose from the important part played by the climate in making the soil. Geological data, however, are invaluable for providing information in respect to water-supply, where it is essential to know the nature and position of the various strata, their permeability and their relation to the ultimate supplies of water. Studies of this kind would be useful in famine areas.

Other problems of soil-survey arise in connection with forestry. Forest conservation is an effective way of reducing or even preventing soil-erosion. A vast scheme has been projected in the United States where millions of acres of land have been ruined by erosion for planting up a great forest belt 100 miles long and ten miles wide ; it will take something like a hundred years to complete, but it is hoped that it will be effective in preventing a good deal of erosion that is now taking place. Soil-erosion is one of the problems that no country can afford to neglect, and certainly India cannot neglect it.

There is another important problem India owes to soil science in the rest of the world. It was in South India that Buchanan many years ago first

described certain soils as lateritic and so introduced a totally new group of soils to scientific workers. Soil science has changed a great deal since then and there has been a great deal of discussion as to what is and what is not a laterite soil. J. B. Harrison showed that apparently similar soils occur widely in British Guiana : Screver has described them in Malay and Mohr in Java ; they have been widely recognised in Africa. But India remains as the land of their birth, so to speak, and it is in India that they should be fully studied. What are they ? What are their agricultural properties ? How can they be improved ? A good deal of work has been done in recent years in the West Indies and in Africa. In India, there are great opportunities for further studies. You must remember that the idea first arose in India and you are in a good position for developing further knowledge.

Another set of problems on which you are in an almost unique position for study is in connection with the black soils of India. These are entirely different from the black soils of Russia, though apparently they are something like some of the black soils of Africa. You are able to supply the information about the soils which soil investigators in many other parts of the world are desiring.

Reference was made by Mr. Wad to the admirable data collected by the Revenue Department. This Department has considerable knowledge of the relative values of the soils and indeed India is better served in that respect than many other countries. The basis of classification adopted by the Revenue Department is essentially the soil texture modified by such factors as depth, proximity to water-supply, duration and intensity of previous cultivation, etc.

One of the modern methods of soil-survey is to have it on the soil profile. Unfortunately, most of the Indian soils I have seen have no very marked profile such as can be seen in other parts of the world. A good deal of soil work is being done in India and it would undoubtedly be a great advantage to put all local surveys on to a uniform basis so that the results can be collated and brought together. It is not necessary to adopt any one basis of classification. Soil investigators are by no means agreed on the matter, and numerous systems have been proposed. The important point at the present time is that the soils should be fully described and that the same methods of description should be used by all Indian workers. Dr. Puri's suggestion is sound that the Indian soil workers should constitute a committee to draw up an agreed basis for describing the soils and should indicate the methods of examination to be adopted. It would further be necessary to arrange for some central body or for some institution to collate the results and prepare the maps and so to put data on record that will be useful to all concerned with soil management and with agriculture.

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REVIVAL OF THE BUREAU OF EDUCATION IN INDIA

The following communique [No. F. 122-11/35-E (C. A. B.)], dated the 7th June 1937, issued by the Government of India in the Department of Education, Health and Lands, is reproduced for general information :—

1. A Bureau of Education was established at the Headquarters of the Central Government under the Educational Commissioner with the Government of India in 1915. The main duties of the Bureau were to collect and collate educational information in India and abroad ; to arrange for the publication of educational reports on different subjects, including an annual report and a quinquennial review on the progress of education in India ; to supervise the Imperial Secretariat Library (including its own library of educational books) ; to arrange for the conduct of certain examinations and to reply to enquiries from official as well as non-official bodies and individuals. A valuable activity of the Bureau was the publication of occasional reports and pamphlets on educational problems in India. These reports dealt with such important subjects as the training of teachers, school laboratories, adult education, media of instruction, drawing and manual training, vernacular education, education of factory children, visual instruction, school libraries, mental intelligence tests, etc. Subsequently a Central Advisory Board of Education was created in 1920 under the chairmanship of the Educational Commissioner with the Government of India. The Board offered expert advice on all important educational matters that were referred to it and conducted educational surveys, whenever required. It was felt that, with the devolution of responsibility for education to the Provinces under the Government of India Act, 1919, such an organisation would serve to keep local Governments in touch with educational activities, aims and progress in the different Provinces and act as a clearing house of educational ideas. This expectation was fully realised and both the Bureau and the Board served a very useful purpose.

2. As a result, however, of the recommendations of the Indian Retrenchment Committee of 1921, the Advisory Board and the Bureau were abolished in the interests of economy. Since the ab olition of the Bureau, its work has been continued, but on a very limited scale, by the Educational Commissioner with the Government of India.

3. Even at the time of abolition, the Government of India had doubts as to the wisdom of this step, which was taken under pressure of the then paramount need for economy. The passage of years progressively emphasised the need for the revival of the Board and the Bureau. The systems of education in the different parts of India were subjected to stresses which revealed the need for review and reform. The Government of India gave careful thought to the matter and decided not to stand aloof but to associate themselves with the pressing task of educational reconstruction. They, therefore, revived in 1935 the

Central Advisory Board of Education in India, *vide* their Resolution No. F. 122-3/35, dated the 8th August 1935. The Bureau was not revived at the same time, as the Government of India considered that, apart from financial considerations, the precise functions and establishment of the Bureau could best be defined after the opinion of the Board had been obtained.

4. The Central Advisory Board of Education considered the question of the revival of the Bureau of Education at its first meeting held in New Delhi in December 1935 and resolved that the Bureau of Education should be revived under the control of the Educational Commissioner with the Government of India, to deal specifically with the collection and dissemination of literature relating to educational problems in the various provinces. Accepting the advice of the Board, the Government of India have decided to revive the Bureau of Education in India with the following functions :

(*a*) to maintain a reference library of educational books and periodicals,

(*b*) to collect and disseminate literature relating to educational problems in the various Provinces,

(*c*) to issue from time to time educational pamphlets and occasional reports likely to be of interest and value to provincial departments of education,

(*d*) to issue an annual report on the progress of education in India and a quinquennial review of education in India, and

(*e*) to supply information on educational subjects at the request of provincial educational officers or authorities.

The Bureau of Education will be under the control of the Educational Commissioner with the Government of India.

The Secretary of the Central Advisory Board of Education, who is appointed by the Government of India, will be the Curator of the Bureau of Education.

5. A library of educational books, which will gradually be extended, has recently been attached to the office of the Central Advisory Board of Education. The books may be consulted by any one interested, without payment of any fee.

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STATISTICS OF THE PRODUCTION OF CERTAIN SELECTED INDUSTRIES IN INDIA

THE following statistics are reproduced from the " Monthly Statistics of the Production of Certain Selected Industries of India," No. 9, December,

1936, issued by the Director-General of Commercial Intelligence and Statistics, Calcutta :—

December, 1936

Detailed statement of the quantity and description of jute manufactures produced in India

Description		Month of December			Nine months, April to December		
		1934	1935	1936	1934	1935	1936
I.—Twist and yarn	tons	3,621	3,517	4,816	33,502	32,321	39,373
II.—Manufactures—							
Canvas	tons	65	65	165	1,211	991	1,504
	yds.	116,209	119,459	342,334	2,184,006	1,741,650	2,926,274
Gunny bags—							
(a) Hessian	tons	4,023	4,147	5,130	34,035	33,403	50,607
	No.	9,516,182	8,838,305	12,015,796	69,655,207	68,999,283	105,967,604
(b) Sacking	tons	45,228	46,600	57,357	403,081	427,612	480,657
	No.	44,904,161	45,794,126	55,653,027	385,431,787	414,991,918	457,673,580
Gunny cloth—							
(a) Hessian	tons	24,336	29,232	42,909	217,668	244,899	340,475
	yds.	92,327,023	113,356,229	165,076,325	828,456,419	949,084,117	1,310,354,681
(b) Sacking	tons	2,205	2,136	2,930	19,041	19,206	21,837
	yds.	4,730,480	4,577,236	6,665,667	42,459,309	41,125,209	48,989,936
Other manufactures including rope and twine.	tons	292	301	488	2,605	2,568	4,525
Total	tons	79,770	85,998*	113,705	711,143	760,999*	938,978
	yds.	97,173,712	118,052,924*	172,084,326	873,049,734	991,950,976*	1,362,270,891
	No	54,420,343	54,632,431*	67,668,823	455,086,994	483,991,201*	563,641,184

* Revised.

Detailed statement of the quantity and description of sulphuric acid produced in India

Description	Month of December			Nine months, April to December		
	1934	1935	1936	1934	1935	1936
	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.
Ordinary or non-fuming sulphuric acid.	53,484	57,906*	43,223	401,405	423,120*	362,839
Fuming sulphuric acid	...	...	...	43	54	12
Total	53,484	571,906*	43,223	401,448	423,174*	362,851

Detailed statement of the quantity and description of sulphate of ammonia produced in India

Description	Month of December			Nine months, April to December		
	1934	1935	1936	1934	1935	1936
	Tons	Tons	Tons	Tons	Tons	Tons
Neutral	1,601	1,405	1,467	10,173	13,312	11,729
Acid	19	19	48	167	177	1,578

Detailed statement of the quantity and description of sugar produced in India

Description	Month of December			Nine months, April to December		
	1934	1935	1936	1934	1935	1936
	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.
(i) Khandsari sugar* . .	12,435†	7,184†	3,798	89,319†	37,161†	29,687
(ii) All other sugar except Palmyra sugar.	2,163,393†	3,185,799†	3,188,655	5,245,779†	5,722,395†	7,312,855
(iii) Palmyra sugar . .	27,736	16,876	22,778	183,744	159,574	184,864
TOTAL .	2,203,564†	3,209,859†	3,215,231	5,518,842†	5,919,130†	7,527,406

* Figures relate to excised issues only.
† Revised.

Detailed statement of the quantity and description of wheat flour milled in India

[In Bazaar Maunds of 82 2/15 lbs. each.]

Description	Month of December			Nine months, April to December		
	1934	1935	1936	1934	1935	1936
	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.
Flour	476,971	425,882	541,899	4,259,093	4,380,532	4,172,918
Atta High grade . .	339,783	278,846	209,380	2,686,729	2,513,130	2,472,008
Atta Low grade . .	117,017	131,637	186,690	1,044,638	1,225,839	1,236,175
Bran	235,972	204,549	238,767	1,985,985	2,043,683	1,912,777
Soojee	48,707	44,460	64,548	498,547	416,867	436,677
Others	6,594	7,524	7,176	51,661	63,208	71,838
TOTAL .	1,225,044	1,092,898*	1,338,460	10,526,658	10,643,259	10,302,398

* Revised.

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HERBAGE ABSTRACTS

The first issue of the seventh volume * (March 1937) of this exceedingly useful publication has just appeared. It consists of 89 pages, excluding the indexes and is a comprehensive set of abstracts of every published paper connected distantly or remotely with herbage and forest plants throughout the world. The editors interpret their duties very liberally and we find amongst the titles such items as " Bird and Mammal Communities and Field Borders in Northern Illinois ", " Plant-maps for the Netherlands ", 1 : 3,000,000, Part 1, compiled by The Institute for the Investigation of the Vegetation in the Netherlands (I. V. O. N.) and " Reclamation of Black-alkali Soils with various kinds of Sulphur ". The particular issue of Herbage Abstracts received is printed on one side of the paper only for the use of library and persons wishing to maintain card indexes. This means that the volume can be cut up for cards or insertion in catalogues. This publication is issued by the Imperial Bureau of Plant Genetics : Herbage Plants, Aberystwyth, Great Britain, which also publishes *Herbage Reviews*. The following are the rates of subscription :—

Herbage publication series

Reviews—Abstracts—Bulletins.

	Shillings
Herbage Reviews alone	10
Herbage Abstracts (normal) either alone or with Herbage Reviews	15
Herbage Abstracts (one side)* either alone or with Herbage Reviews	20
Herbage Abstracts, both issues	30
Herbage Abstracts, both issues and Herbage Reviews	35

* This is the issue just mentioned.

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IMPROVEMENT OF CATTLE

During prolonged periods of dry weather the rate of growth of fodder grasses slows down and an area which is ample during wet weather to supply the needs of the owner's herd becomes inadequate. Some cheap foodstuffs to supplement the diminished supply of fodder grass during such periods is necessary. The drop in the yield of the fodder grasses could, of course, be obviated by irrigation but this is seldom practicable. Possible supplements which are worthy of trial include cassava (tapioca) and the juicy stems of plantains.

* Published by the Imperial Bureau of Plant Genetics: Herbage Plants, Aberystwyth, Great Britain, price 20*s*.

The great value of the roots of cassava as a standby during long periods of drought has been emphasised by Stewart, Principal Veterinary Officer in the Gold Coast, during the past few years. That cattle would eat the roots of cassava if they had access to them was fairly well known but they had never been used to any extent as a cattle food, chiefly because of the fear that poisoning would result.

Stewart's experiments showed that the danger was greatly exaggerated if reasonable precautions were taken. He found that cattle readily eat the chopped roots and improved in condition when fed on them.

Plantain stems cut into slices are readily eaten by cattle and where available are a very useful supplementary feed, especially during dry weather when succulent foods are very scarce. (Extract from *The Tropical Agriculturist*, April 1937).

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THE NUTRITIVE VALUE OF PASTEURIZED MILK

One of the statements most frequently made by opponents of pasteurization is that the nutritive value of milk is deleteriously affected as the result of treatment by heat. No satisfactory evidence in support of this contention has yet been brought forward. It is true that certain workers have carried out experiments the results of which have been regarded as favouring raw as opposed to pasteurized milk, but careful examination of their protocols has usually revealed some source of error that has rendered their conclusions untrustworthy. On the other hand there have been a number of workers who have failed to find any significant difference between the nutritive value of raw and that of pasteurized milk. With the rapid increase in the extent of pasteurization that is occurring at present and the growing demand for powers of compulsory pasteurization by towns like Glasgow and Poole, whose experience of raw milk has been unfortunate, it is important that this question should receive a definite answer. Considerable progress towards this end is being made by a group of workers at the National Institute for Research in Dairying at Reading and the Rowett Research Institute at Aberdeen, who are engaged under the auspices of the Milk Nutrition Committee of the Milk Marketing Boards in making careful observations on the comparative nutritive value of raw and pasteurized milk. The first report of this committee, which has just been published, mainly concerns experiments on rats.

Observations on the individual constituents of milk showed that, when subjected to commercial pasteurization by the holder method (145°-150° F. for thirty minutes), milk lost about one-fifth of its vitamin C content and a certain but unmeasured amount of its vitamin B complex. No change was observed

in the vitamin A or carotene content of the milk, in the biological value of the proteins, or in the availability of the calcium or phosphorus.

Experiments on litter mates, carried out with whole milk given in a quantity of 70-80 c.cm. daily, failed to show any difference between the nutritional value of raw and pasteurized milk as judged by such criteria as gain in weight, body-length, or the calcium and phosphorus content of the carcasses. (Extract from *The British Medical Journal*, May 8, 1937.)

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FOOT-AND-MOUTH DISEASE

THE task of investigating this important and damaging disease of live-stock has proved to be one of exceptional difficulty. As long ago as 1924 the British Foot-and-Mouth Disease Research Committee was formed "to initiate, direct and conduct investigations into foot-and-mouth disease, either in this country or elsewhere, with a view to discovering means whereby the invasions of the disease may be rendered less harmful to agriculture."

That foot-and-mouth disease may be caused by several closely allied but serologically different viruses makes the difficulty of prevention by any type of vaccine almost insuperable and the failure to work out an effective method of inoculation represents the major disappointment of the investigation. Valuable information has, however, been accumulated as to the resistance of the virus to physical and chemical influences. It has been shown, for instance, that the virus may resist cold-storage temperatures for prolonged periods and that it can be dried on fabrics and other materials and retain its virulence. These observations have led the Ministry to introduce orders compelling the cooking of animal products before feeding them to live-stock and to make certain requirements as to wrapping materials. These regulations should eliminate some at least of the outbreaks. Important advances have also been made in the simplification and effectiveness of disinfection methods. Increasing reliance is now being placed both here and in Germany on alkalis, such as washing soda or dilute caustic soda, in disinfecting contaminated objects and premises. (Extract from *The Lancet*, May 29, 1937.)

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THE SHORTAGE OF VETERINARY SURGEONS

THE two branches of medicine, the human and the veterinary, play individual and combined parts, and any shortage in the total number of the veterinary body may reflect seriously upon the joint efforts. For the diseases of animals which are communicable to man are far spread in their evil influences. In this

country anthrax, glanders, and rabies are now fortunately rare if terrifying spectres. Their eradication is mainly due to the control exercised by the veterinary department of the Ministry of Agriculture and Fisheries over their respective sources of origin, bovine, equine, and canine. It is to be hoped that we shall never again in this country have to fear these terrible menaces to man ; but this security depends upon the continuance of the present keen veterinary inspection of each port where animals are allowed to land, as well as on quarantine laws and those governing the importation of animal products. Efforts directed towards prevention of the spread to humans of brucella infections and of foot-and-mouth disease must also be recalled. In the inspection of meat for human food the man who must by virtue of his training know most about the matter is the veterinary surgeon. He is the one best qualified to detect disease in the food animal before slaughter and to guarantee the soundness of the flesh when dressed for human consumption. And in the present fight against tuberculosis, which is an uppermost theme in every mind, the medical man works with the veterinarian ; and only through such collaboration can measures of prevention be considered or a successful conclusion to endeavour be anticipated.

The young man entering the veterinary profession to-day will find that he has joined a service which is increasingly needed and valued ; the whole world counts on his help. But the more this is so the more evident is it that the educational course must become increasingly comprehensive, and the tests to be satisfied grow harder. An extension of the curriculum has already been made, and university courses are running concurrently with those connected with the practising diploma, but the danger of discouraging candidates by insisting on too prolonged and arduous a course of study must be borne in mind. Students entering the veterinary profession now will command better material rewards than has been possible in the past, as there are almost limitless possibilities of promoting the welfare of the human as well as the animal kingdom. (Extract from *The Lancet*, May 1, 1937.)

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FEEDING VALUE

An outstanding demonstration of the value of dried grass in milk production is afforded by Dairy House Farm, near Middlewich, Cheshire. This farm of 170 acres carries a milking herd of 60-70 head, and has a grass drier. Since the autumn of 1935 these cows, together with heifers and calves, have had practically no home-grown or purchased concentrated foods other than dried grass. Milk yields have been maintained, the condition of the herd is excellent and the colour of the milk has remained practically uniform throughout the year. Grass

drying has made the farm almost completely self-supporting in food-stuffs for cattle. (Extract from *The Farmer and Stock-breeder*, May 4, 1937.)

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WORLD PRODUCTION AND CONSUMPTION OF ARTIFICIAL MANURES

THE British Sulphate of Ammonia Federation, Ltd., in their annual report for 1935-36 give some very interesting figures. The year was a record one for the production of synthetic sulphate of ammonia, cyanamide, nitrate of lime and also for total production and total consumption of nitrogen. The total world production of pure nitrogen was 2,378,000 metric tons and the total consumption 2,400,000 of which the agricultural consumption was about 2,068,000. During the year under review there was an increase of 308,000 metric tons of nitrogen or about 14·9 per cent on the year previous (1934-35). The production in Chile increased by 13,000 tons or seven per cent, and output in other countries by 295,000 tons or sixteen per cent. The most marked increases in manufactured nitrogen output were in Germany, Japan, the United States of America and Russia. In spite of all this, synthetic nitrogen plants were considered to have operated at only about forty-eight per cent of their capacity during the year ; the actual world production capacity for synthetic nitrogen, including cyanamide, being estimated at 3,700,000 tons of nitrogen. The total consumption increased by 329,516 tons or about 15·9 per cent, following an increase of 10·3 per cent last year. In Britain the prices were the same as in 1934-35. England and Wales used 3·5 per cent, Scotland 0·7 per cent and Ireland 15·7 per cent more sulphate of ammonia than in the preceding year. The large increase in Ireland was due to the larger areas under wheat and beet in the Free State and to improved prices for potatoes and grass seed in Northern Ireland.

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WOODHOUSE MEMORIAL PRIZE

THE following announcement has been received from the Director of Agriculture, Bihar :—

In memory of Mr. E. J. Woodhouse, late Economic Botanist and Principal of Sabour Agricultural College, who was killed in action in France in 1917, a biennial prize in the form of a Silver Medal and books of a combined value of Rs. 100 will be awarded to the writer of the best essay on a subject to be selected from the list noted below. The length of the essay should not exceed 4,000 words.

The competition is open to graduates of Indian Universities and to Diploma holders and Licentiates of recognized Agricultural Colleges in India who are not more than 30 years of age on the date of submission of their essays.

Papers should be forwarded to the Director of Agriculture, Bihar, Patna, before the 30th November, 1937.

Failing papers of sufficient merit no award will be made. Essays must be typewritten on one side of paper only.

List of subjects

1. Hybrid vigour in plants and its significance in plant breeding and agriculture.
2. Agricultural problems of the Indian Sugar Industry and their solution.
3. The importance of purity and quality of seeds of farm crops and how to prevent their deterioration.

ABSTRACTS

Diseases of the tea bush in the Kangra Valley, Punjab. I. H. Chaudhuri, V. S. Kapur, K. L. Bhatia and J. S. Anand (*Ind. J. Agric. Sci.* **7**, 565)

Various diseases of the tea bush from the tea gardens in Palampur (Kangra) have been studied by the authors. Of these the following diseases have been described in the paper :

1. Grey blight (*Pestalozzia theae*).
2. Brown spot disease (*Phoma theicola*).
3. Brown blight (*Colletotrichum camelliae*).
4. Scabbing of leaves (combined effect of *Phoma, Pestalozzia* and *Colletotrichum*).
5. Copper blight (*Guignardia camelliae*).
6. Internal root disease (*Botryodiplodia theobromae*).
7. A stem disease (*Hendersonia theicola*).
8. Red rust of tea (*Cephaleuros mycoidea*).

The causal organisms have been isolated and grown in culture and their characteristics on the host plants as well as on various culture media have been described. Inoculation experiments have been performed in all cases to establish the pathogenicity of the organisms. Of the diseases described, the Grey blight (*Pestalozzia theae*) and Brown blight (*Colletotrichum camelliae*) are responsible for the greatest loss in that area. (*Authors' abstract*)

Studies on the root-rot disease of cotton in the Punjab. IV. The effect of certain factors influencing incidence of the disease. R. Sahai Vasudeva (*Ind. J. Agric. Sci.* **7**, 575)

The bearing of soil moisture on the incidence of the root-rot disease of cotton has been shown. At fifteen per cent and twenty per cent soil moisture the causal fungi produce heavy infection.

Evidence of periodicity in parasitic activity of the causal fungi has been correlated with the time of sowing ; showing thereby that a severe attack of the disease may be evaded by skipping over the period of optimum activity of the causal organisms. (*Author's abstract*)

Awnedness and its inheritance in rice. R. L. Sethi, B. L. Sethi and T. R. Mehta (*Ind. J. Agric. Sci.* **7**, 589)

Awnedness in rice and its inheritance have been discussed. The variability of the awn and the influence of environment on its development have been presented to

show that crowding of plants tends to increase awn development. This is perhaps not due to deficient nutrition because even when adequate nutrition was supplied by heavy manuring the relation between the crowding and awnedness remained unaltered. In inheritance the length of awns was found to be governed by three or more genes acting cumulatively. The colour of awn was due to a simple gene. (*Authors' abstract*)

Sampling of sugarcane for chemical analysis. RAMJI NARAIN AND AZAMAT SINGH (*Ind. J. Agric. Sci.* **7**, 601)

THE paper reports the results of a chemico-statistical study of this problem. The investigation was undertaken with the object (*i*) of fixing the limits of accuracy within which the mean values of several constituents of sugarcane from any plot should lie, so as to yield reliable information about the influence of different treatments on the condition of the crop and (*ii*) of selecting the size and manner of taking the sample for analysis which would be subject to an error not greater than the limits of tolerance thus fixed. The value for the different constituents of cane from samples of various sizes have been examined statistically and from the constants so obtained the limits of accuracy which may be tolerated for the mean value of these cane constituents have been determined. For ordinary routine analyses a sample consisting of ten stools picked at random from the entire field has been shown to give quite accurate results. In special cases when still greater accuracy is desired ten replicate samples each consisting of ten stools are recommended. If, however, the results are to be expressed on cane and also when a reliable estimate of juice percentage is required, a sample consisting of twenty-five stools will be necessary. The figures for sucrose and total solids have been found to be accurate within a range of about $\pm 0 \cdot 5$ and for glucose within $\pm 0 \cdot 10$, when a nine stool sample is taken and those for juice percentage within $\pm 1 \cdot 5$ with a twenty-four stool sample. The limits of accuracy for the mean of ten samples of nine stools each will be $\pm 1 \cdot 3$, $\pm 0 \cdot 14$ and $\pm 0 \cdot 17$ for juice, total solids and sucrose respectively. (*Authors' abstract*)

Relative susceptibility of some wild and cultivated potato varieties to an epidemic of late-blight at Simla in 1936. B. B. MUNDKUR, B. P. PAL AND PUSHKAR NATH (*Ind. J. Agric. Sci.* **7**, 627)

LATE blight caused by *Phytophthora infestans* appeared in a virulent form at Simla in 1936, apparently favoured by the especially wet and cloudy weather prevailing in the months of July and August. The fungus was isolated and compared with an authentic culture of *P. infestans* and the two isolates were found to agree in all major characteristics including sporangial size, leaving no doubt regarding the identity of the isolate from Simla.

The epidemic enabled the resistance or susceptibility of a large number of wild and cultivated varieties growing at the Potato Breeding Sub-Station to the physiologic race of the late-blight fungus occurring at Simla to be determined under very severe

infection conditions. *Solanum Antipoviczii*, *S. demissum* and *S. neoantipoviczii* remained immune to attack, while other species and varieties showed reactions ranging from high resistance to complete susceptibility. (*Authors' abstract*)

The grape-vine thrips (*Rhipiphorothrips cruentatus* Hood) [Thripidae: Terebrantia: Thysanoptera]. A. RAHMAN AND NAND KISHORE BHARDWAJ (*Ind. J. Agric. Sci.* **7**, 633)

RHIPIPHOROTHRIPS CRUENTATUS Hood has been found on the leaves of grape-vine, rose, *Terminalia arjuna*, and *Eugenia jambolana* in the Punjab. In South India it has also been collected from the leaves of *Odina wodier*, *Terminalia catappa*, *Anacardium occidentale*, *Caryea arborea*, and the flowers of *Calotropis*.

Descriptions of the egg, nymphal, pupal, and adult stages are given.

Life-history.—Adults copulate two to ten days after emergence, copulation lasting for fifteen to forty-five minutes. Eggs are laid singly in slits on the underside of a leaf. A female lays fifteen to fifty eggs. The largest number of eggs are laid in July. During the active period the duration of the various stages is as follows : egg three to eight days ; first two nymphal instars six to twelve days ; prepupa three to eight days ; pupa two to five days. The entire life-cycle is thus completed in fourteen to thirty-three days. The pest hibernates in the pupal stage from the middle of November to March in the top three inches to seven inches of the soil. Adults emerging from these pupae start infestation in the spring. Compact soil interferes with pupal hibernation and emergence of adults.

Parthenogenesis, dispersal, progression on water and submergence of adults are discussed.

Both adults and nymphs do damage. Yield from the attacked plant is considerably lowered. The fruit obtained from such plants is of low quality and fetches low price.

The *Jaishi* variety is immune to the attack of this pest but the other varieties such as *Tur*, *Tus*, *Badana*, *Sursavi*, and *Kishmish* are, however, very susceptible.

The description and life-history of *Thripoctenus maculatus* Watrstn (Eulophidae: Hymenoptera)—an important endoparasite—are given.

Control.—Root opening followed by the replacement of dug out soil by fresh soil is a good preventive measure. The pest can be effectively controlled by spraying with tobacco decoction diluted with four parts of water. It gives a mortality of about 97-98 per cent. *Ak* decoction and Black Leaf 40 were also tried and proved very useful.

Tent fumigation with hydrocyanic acid is also very effective, but is expensive. (*Authors' abstract*)

Germination of fungal spores in relation to atmospheric humidity. S. CHOWDHURY (*Ind. J. Agric. Sci.* **7**, 653)

EXPERIMENTS were conducted to determine the relation of atmospheric humidity to the germination of spores of *Acrothecium penniseti* Mitra, *Alternaria brassicae* (Berk.)

Bolle, *Helminthosporium frumentacei* Mitra, *Cladosporium herbarum* (Pers.) Link, *Colletotrichum falcatum* Went, *C. lindemuthianum* (Sacc. and Magn.) Br. and Cav., *Gloeosporium tabernaemontanae* Speg. and *Phyllosticta cajani* Syd. The minimum relative humidity for spore germination was found to be ninety per cent for some while others did not germinate below ninety-five per cent relative humidity. (*Authors' abstract*)

Determination of fats in biological material. II. The alkali hydrolysis method. P. A. SESHAN (*Ind. J. Vet. Sci. & Anim. Husb.* **7**, 273)

PREVIOUS work by the same author on the alkali hydrolysis method, as applied to *ragi* straw and faeces, having indicated a formation of fresh quantities of fatty acids, similar experiments were undertaken with pure carbohydrates, such as cotton, cellulose, starch and dextrin.

The results obtained were in complete accord with the findings previously recorded.

It is, therefore, suggested that whenever carbohydrate material is involved, the direct saponification of the tissue with alkali should be abandoned. (*Authors' abstract*)

On a piroplasm of the Indian cat (*Felis domesticus*). M. Y. MANGRULKAR (*Ind J. Vet. Sci. & Anim. Husb.* **7**, 269)

IN 1904 Lingard made the statement that, amongst other animals, cats in Bareilly (U. P.) were subjects of spontaneous piroplasmosis. Since then only three other records of the occurrence of piroplasmosis in felines (Davis, 1929 ; Wenyon and Hamerton, 1930 ; and Carpano, 1934) appear to have been made.

In the course of routine post-mortem examinations, the author had the opportunity of examining several feline carcasses, and in the present paper he reports from the blood of debilitated cat a piroplasm which resembles morphologically the one described as *Babesia felis* by Davis from a Sudanese wild cat. (*Authors' abstract*)

Experiments on the transmission of rinderpest through the agency of *Stomoxys calcitrans*. S. K. SEN AND ABDUS SALAM (*Ind. J. Vet. Sci. & Anim. Husb.* **7**, 219)

IN a previous communication published from this Institute, Bhatia (1935) reported having obtained negative results in every one of a series of four experiments carried out by him to test the possibility of rinderpest being transmitted by *Stomoxys calcitrans*, the number of flies used by him in these experiments ranging from three to fourteen. It was, however, considered desirable to carry out more extensive trials with this species of fly before completely eliminating it as a possible transmitter of the disease. Several hundred wild flies, divided in batches, were fed on bulls artificially infected with rinderpest and they were allowed to complete their feed on a healthy bull, the number of infective bites thus inflicted amounting approximately to 1081 spread over a period of

thirty-two days The bull, however, did not develop the infection during an observation period of sixweeks, at the end of which it was tested for immunity by the inoculation of virulent blood and it died after showing typical symptoms of rinderpest. A method is described for feeding, by the 'interrupted' method, a large number of flies singly, within a limited period of time. (*Authors' abstract*)

The occurrence of spinose ear tick (*Ornithodorus megnini* Duges) in India.

S. K. SEN (*Ind. J. Vet. Sci. & Anim. Husb.* **7**, 213)

ON the 15th January 1936, a consignment of ticks collected post-mortem from inside the ears of an imported Australian horse, that had developed symptoms of in-co-ordination of movement as a result of the infestation, was received at the Mukteswar Institute for identification, from Saugor, Central Provinces. These on examination proved to be the nymphs of *Ornithodorus megnini*, the well-known spinose ear tick of America, the occurrence of which had not been previously recorded from India. Subsequent to this, several, other consignments of the parasite were received from the same locality and also from Mhow and Ahmednagar, but none of the affected animals in these cases developed any marked clinical symptoms that might be attributed to the infestation.

Two adult ticks—a male and a female—were enclosed together in a tube on the 2nd May and eggs were first seen on the 26th May and larvae on the 18th July. On the 29th July, about thirty of the larvae were introduced into the ear of a country-bred pony, a special device being adopted to prevent the ticks from escaping. The pony, however, did not develop any clinical symptoms as a result of the infestation during an observation period of thirty-five days. When the ear was examined at the end of this period, four of the larvae were found to have changed to fully-engorged nymphs.

It is very probable that *O. megnini* has been introduced into India with stock imported from America or South Africa, which are the only other localities where the parasite is known to occur.

The paper gives a brief description of the morphological features of the parasite and summarizes the available information concerning its bionomics and the pathological effects known to be caused by it in other countries. (*Authors' abstract*)

REVIEWS

A Microscopical Examination of Wheat Grain. COL. BRERETON FAIRCLOUGH *Tech. Education Series Pamphlet* No. 14, 1937, 44 pp. Published by the National Joint Industrial Council for the Flour Milling Industry, 52, Grosvenor Gardens, London, S. W. 1. Price 6*d.* net.

THE purpose of this useful pamphlet is to enable students and especially those engaged in flour milling to understand the structure of the wheat grain and the functions of the several parts of which it is made up. A detailed description of each part of the grain is given and its structural and functional relationships are discussed. The part played by the enzymes in seed germination is described in some detail. There is also a discussion on the manner in which the peculiarities of the structure of the grain in different varieties affect the milling qualities.

The pamphlet is written in language which can be understood by everybody, and is provided with a small glossary of technical terms. The illustrations are very clear. [B. P. P.]

Some Common Wild Grasses, Sedges and Pasture Land Legumes of Assam. BY S. K. MITRA and D. M. SEN GUPTA. Printed at the Assam Government Press, Shillong, 1934.

ASSAM, on account of its heavy rainfall lasting over considerable number of months of the year, is one of the places in India where grass should have very favourable conditions. The publication under reference, after a short description of the geography of Assam and a rough classification of grasslands, gives short notes of from two to ten lines each on sixty-six species of grasses, fourteen species of Cyperaceae and four species of wild Leguminoseae. These notes include remarks regarding fodder and grazing value. Many of the grasses are found in other parts of India and some are more or less confined to Assam or to similar areas. The publication is a useful compendium of facts and observations. [W. B.]

Milk : the Most Perfect Food. BY N. N. GODBOLE. Published by the " Leader " Press, Allahabad, 1936. Price Rs. 3.

THIS book contains twenty-two chapters in which are discussed various aspects of milk and milk products, such as imports of milk products, total production of milk per year in India, provincial distribution of the milch cattle and milk, composition of different types of milk and their nutritive values, use of various milk products, breeding or feeding of milch cattle and tables of food-values of some grains,

cereals and fruits. In addition, there are chapters on Vedic and Ayurvedic references regarding milk and its uses, vegetarian *vs.* non-vegetarian foods, milk and its medicinal uses, including European proverbs regarding milk and what Mussolini says about it. Comments are also made on tea, cocoa, coffee, tobacco and alcoholic drinks.

The reviewer believes that any book which deals with the manifold uses of milk and advocates the greater consumption of milk and milk products by people of all ages in this country should be welcome by all scientific workers. There is no doubt that the speech delivered recently by His Excellency the Viceroy in advocating more use of milk has stimulated greatly the interest on the subject and this book may be a result of this increased interest. The book contains a large amount of valuable data, but the reviewer feels that the author has written the book in a hurry and the results have been loosely presented, many of the subjects being dealt with very superficially. It is not necessary to write at length against non-vegetarian diet in order to induce more milk consumption and the author's idea of showing various stages of humanitarian levels should not have been incorporated in a scientific monograph. Altogether the book has become a propagandist publication in which the primary object of concentrating one's attention to the greater use of milk and milk products has often been forgotten in advocating the use of a vegetarian diet as against a non-vegetarian diet. Milk is an important constituent of diet for growing children irrespective of whether they get a vegetarian or a non-vegetarian food and is as much liable to bacterial contamination and deterioration in this hot country as eggs or meat are. Consequently what we should advocate is the greater consumption of good and pure milk and milk products by all classes of people and specially by growing children, and not complicate the issue by dealing with extraneous matters in which opinions differ. There is a great need for the right type of propaganda in favour of a "drink more milk" campaign, but in doing this it is not necessary to mix up pseudo-scientific generalisations with facts which are well established. Much of what has been given in this book is good and the reviewer hopes that it will stimulate the interest of the lay public in the question of the greater use of milk and milk products. [K. C. S.]

NEW BOOKS

On Agriculture and Allied Subjects

The Plant Diseases of Great Britain : a Bibliography. Compiled and annotated by G. C. Ainsworth. Demy 8vo. Pp. xii+273. (London : Chapman and Hall, Ltd., 1937.) 15*s*. net.

The Useful Plants of West Tropical Africa. By J. M. Dalziel. (Being an Appendix to the Flora of West Tropical Africa, by J. Hutchinson and J. M. Dalziel.) (Published under the authority of the Secretary of State for the Colonies.) Roy. 8vo. Pp. xii+612. (London : Crown Agents for the Colonies, 1937.) 18*s*.

The Pests of Fruits and Hops. By A. M. Massee. (Agricultural and Horticultural Handbooks.) Demy 8vo. Pp. 294+27 plates. (London : Crossby Lockwood and Son, Ltd., 1937.) 15*s*. net.

British Grasses and their Employment in Agriculture. By S. F. Armstrong. Third edition. Demy 8vo. Pp. x+350. (Cambridge : At the University Press, 1937.) 15*s*. net.

Sugar : a Case Study of Government Control. By J. E. Dalton. Demy 8vo. Pp. xi+311. (New York : The Macmillan Co., 1937.) 12*s*. 6*d*. net.

The Electrification of Agriculture and Rural Districts. By E. W. Golding. Demy 8vo. Pp. xii+244. (London : English Universities Press, Ltd., 1937.) 16*s*. net.

Conservation of the Soil. By A. F. Gustafson. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Med. 8vo. Pp. xvii+312. (New York and London : McGraw-Hill Book Co., Inc., 1937.) 18*s*.

The Feeding of Crops and Stock : an Introduction to the Science of the Nutrition of Plants and Animals. By A. D. Hall. Second edition, in 3 parts. Part 3 : The Nutrition of Animals and Man. Cr. 8vo. Pp. xi+108. (London : John Murray, 1937.) 3*s*. 6*d*. net.

The Profitable Culture of Vegetables. By Thomas Smith. (Edited, revised and brought up-to-date by W. E. Shewell-Cooper.) Ex. Cr. 8vo. Pp. 348. (London, New York and Toronto : Longmans, Green and Co., Ltd., 1937.) 7*s*. 6*d*. net.

Human Nutrition and Diet. By W. R. Aykroyd. (Home University Library of Modern Knowledge, No. 183.) Fcap. 8vo. Pp. 256. (London : Thornton Butterworth, Ltd., 1937.) 2*s*. 6*d*. net.

Handbook of Physiology and Biochemistry. By W. D. Halliburton and R. J. S. McDowall. Thirty-fifth edition. Demy 8vo. Pp. xi+973. (London : John Murray, 1937.) 18*s*. net.

Marketing Poultry Products. By E. W. Benjamin and H. C. Pierce. Third edition. Med. 8vo. Pp. 401. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1937.) 20*s*. net.

Chemistry of Food and Nutrition. By H. C. Sherman. Fifth edition, completely rewritten. Ex. Cr. 8vo. Pp. x+640. (New York : The Macmillan Co., 1937.) 12*s*. 6*d*. net.

Canning Practice and Control. By Osman Jones and T. W. Jones. Med. 8vo. Fully illustrated. (London : Chapman and Hall, Ltd., 1937.) 25*s*. net.

Laboratory Outline in Filterable Viruses. By Roscoe R. Hyde. (London : Macmillan and Co., Ltd.) 7*s*. 6*d*. net.

The Legal Aspects of Milk Control. By James A. Tobey. Pp. 102. (Chicago : International Association of Milk Producers, 1936.) $3·00.

Handbook for Veterinary Surgeons. By Fred Bullock. Third edition. Pp. 302. (London : Bailliere, Tindall & Cox, 1936.) 7*s*. 6*d*. net.

The Application of Absorption Spectra to the Study of Vitamins and Hormones. By R. A. Morton. Pp. 70, with 25 illustrations. (London : Adam Hilger, Ltd., 1935.) 10*s*. 4*d*. post free.

The Internal Parasites and Parasitic Diseases of Sheep. By Clunies Ross and H. McL. Gordon. Pp. 238, with 46 illustrations. (Sydney : Angus & Robertson, Ltd., 1936.) 25*s*.

The Control of Bovine Tuberculosis in Man. By Nathan Raw. Pp. vii + 128, with 12 plates. (London : Bailliere, Tindall and Cox.) 6*s*.

Animal Micrology. By Guyer Michael F. Fourth revised edition. Pp. xi+331, 76 figs. (Great Britain and Ireland, Cambridge University Press : United States, University of Chicago Press.) 11*s*. 6*d*.

QUARANTINE AND OTHER OFFICIAL ANNOUNCEMENTS

ENGLAND

STATUTORY RULES AND ORDERS 1937, No. 197.

Destructive Insect and Pest, England. The Importation of Plants (Amendment) Order of 1937. Dated March 10, 1937

(D. I. P. 597)

THE Minister of Agriculture and Fisheries by virtue and in exercise of the powers vested in him under the Destructive Insects and Pests Acts, 1877 to 1927 (*a*) and of every other power enabling him in this behalf, orders as follows :—

Commencement

1. This Order shall come into operation on the twelfth day of April, nineteen hundred and thirty-seven.

Prohibition of importation of Chrysanthemum plants

2. For the prevention of the introduction of the Chrysanthemum Midge (*Diarthronomyia hypogaea* F. Low) the landing in England or Wales from any country other than Scotland, Northern Ireland, the Irish Free State, the Isle of Man or the Channel Islands of any Chrysanthemum plant is hereby prohibited except under and in accordance with the conditions of a licence issued by the Minister or by an Inspector.

Restriction on importation of plants

3. The certificates prescribed in Article 4 of the Importation of Plants Order of 1933 (*b*) shall, except in the case of a consignment consisting wholly of potatoes, include a statement to the effect that the consignment does not contain any Chrysanthemum plant.

Procedure where plants are landed in contravention of this Order

4. If any Chrysanthemum plants are landed in England or Wales in contravention of this Order they shall forthwith be destroyed or re-exported at the expense of the importer unless they are otherwise disposed of in accordance with the

terms of a licence issued by the Minister or by an Inspector, and any person failing to comply with the terms of a licence granted under this Article shall be liable to a penalty not exceeding ten pounds, or, in respect of a second or subsequent offence, to a penalty not exceeding fifty pounds.

Definitions

5. In this Order :—

"Minister" means the Minister of Agriculture and Fisheries ;

"Inspector" means an Inspector or other authorized officer of the Ministry of Agriculture and Fisheries ;

"Importer" includes any person who, whether as owner, consignor or consignee, agent or broker, is in possession of, or in anywise entitled to the custody or control of the article ;

"Plant" means living plant and parts thereof (except seeds) for planting.

Short title

6. This Order may be cited as the Importation of Plants (Amendment) Order of 1937, and the Importation of Plants Orders of 1933 to 1936 and this Order may be cited together as the Importation of Plants Orders of 1933 to 1937.

In witness whereof the Official Seal of the Minister of Agriculture and Fisheries is hereunto affixed this tenth day of March, nineteen hundred and thirty-seven.

(L. S.) DONALD FERGUSSON
Secretary.

MALTA

Government Notice No. 91, dated 5th March 1937 issued by the Department of Agriculture, Malta

His Excellency the Governor in virtue of the powers vested in him by Ordinance No. III of 1876 has been pleased to prohibit the importation into these Islands of citrus fruits unless they are free from leaves, whether attached to the fruit or not.

Any such leaves may be removed on arrival at Malta before release and under the control of the Director of Agriculture.

By Command,
H. C. LUKE,
Lieut.-Governor.

LIEUTENANT GOVERNOR'S OFFICE,
THE PALACE, VALLETTA,

GRAND DUCHY OF LUXEMBURG

Plant Quarantine Import Restrictions of the Grand Duchy of Luxemburg

B. E. P. Q.-389, Supplement No. 1, dated March 9, 1937, issued by the United States Department of Agriculture, Bureau of Entomology and Plant Quarantine, Washington, D. C.

Certificate required for potatoes, Tomatoes and Eggplants

The Order of September 24, 1923, has been superseded by that of July 1, 1936. The new decree adds potato wart to the last sentence of the text on page 2 of circular B. E. P. Q.-389, which should now read as follows :—

"These products grown in and shipped from a locality at least 20 km from any infestation of *Leptinotarsa* (Colorado potato beetle) or *Synchytrium* (potato wart) are considered to proceed from an exempt district."

LEE A. STRONG,
Chief, Bureau of Entomology and Plant Quarantine.

Personal Notes, Appointments and Transfers, Meetings and Conferences, etc.

Imperial Council of Agricultural Research

The services of SIR BRYCE BURT, Kt., C.I.E., M.B.E., B.Sc., I.A.S., officiating Vice-Chairman, Imperial Council of Agricultural Research, have been placed temporarily at the disposal of the Commerce Department with effect from the afternoon of 29th May 1937.

MR. N. C. MEHTA, I.C.S., Secretary, Imperial Council of Agricultural Research, has been appointed officiating Vice-Chairman of the Council from the afternoon of 29th May 1937.

KHAN SAHIB BAZLUL KARIM of the Imperial Secretariat Service, Class II, a Superintendent in the Imperial Council of Agricultural Research Department, has been appointed officiating Secretary, Imperial Council of Agricultural Research, from the afternoon of 29th May 1937, *vice* MR. N. C. MEHTA, I.C.S., appointed officiating Vice-Chairman.

COL. SIR ARTHUR OLVER, Kt., C.B., C.M.G., F.R.C.V.S., resumed charge of his appointment as Animal Husbandry Expert, Impérial Council of Agricultural Research, with effect from the 5th July 1937.

The services of MR. F. WARE, C.I.E., F.R.C.V.S., I.V.S., officiating Animal Husbandry Expert, Imperial Council of Agricultural Research, have been replaced at the disposal of the Department of Education, Health and Lands with effect from the afternoon of the 1st July 1937.

RAO BAHADUR M. VAIDYANATHAN, M.A., L.T., F.S.S., Statistician, Imperial Council of Agricultural Research, has been granted leave from the 25th May 1937 to the 16th March 1938.

His Excellency the Governor-General in Council has been pleased to appoint under the provisions contained in Rules 1 and 43 of the Rules and Regulations of the Imperial Council of Agricultural Research, the DEPUTY DIRECTOR OF VETERINARY AND ANIMAL HUSBANDRY, BARODA, as a member of the Imperial Council of Agricultural Research and of its Advisory Board, *vice* the DEPUTY DIRECTOR OF AGRICULTURE, BARODA.

His Excellency the Governor-General in Council has been pleased to re-appoint MR. A. M. LIVINGSTONE, M.A., B.Sc., M.C., Marketing Expert, Imperial Council of Agricultural Research and Agricultural Marketing Adviser to the Government of India, as a member of the Council as well as of its Advisory Board with effect from the 10th May 1937, on which date he relinquished his previous membership of the said bodies.

Indian Central Cotton Committee

In consequence of vacancies caused by the retirement of nominated members, with effect from the 1st April 1937, the following have been nominated to be members of the Indian Central Cotton Committee, Bombay.

By the Central Government

(1) MR. J. C. MCDOUGALL, M.A., B.Sc., Director of Agriculture, Central Provinces, to represent the Central Provinces Agricultural Department.

(2) MR. P. V. DESHMUKH, Managing Proprietor, Vidarbha Mills, Ellichpur, Berar, to represent the Cotton Manufacturers in the Central Provinces and Berar.

(3) THE DIRECTOR OF AGRICULTURE, UNITED PROVINCES (*ex-officio*) to represent the United Provinces Agricultural Department.

By the Darbars of the Indian States in Rajputana and Central India

MR. T. R. LOW, I.A.S., Director of the Institute of Plant Industry, Indore, to be their joint representative.

The following have been appointed to be members of the Indian Central Cotton Committee :—

1. ECONOMIC BOTANIST (COTTON) TO THE GOVERNMENT OF THE UNITED PROVINCES from the 1st April 1937 to the 15th November 1937.
2. MR. P. B. RICHARDS, A.R.C.S., F.E.S., I.A.S., Entomologist to the Government of the United Provinces from the 16th November 1937.

MR. S. S. SAMOILYS, of Messrs. Ralli Brothers, Limited, Bombay, has been nominated by the Bombay Chamber of Commerce to be a Member of the Indian Central Cotton Committee, Bombay, *vice* MR. M. S. DURUTTI, resigned.

In consequence of the vacancy caused by the resignation of MR. J. HURSCHLER, the Tuticorin Chamber of Commerce has nominated MR. J. VONESCH to be a member of the Indian Central Cotton Committee, Bombay.

Indian Central Jute Committee

MR. NURUL AMIN, B.L., Pleader, Mymensingh, has been nominated by the Government of Bengal to be a member of the Indian Central Jute Committee, *vice* DR. N. C. SEN GUPTA, resigned.

Indian Lac Cess Committee

Under the provisions of sub-sections (2) and (3) of Section 4 of the Indian Lac Cess Act, 1930 (XXIV of 1930), as amended by the Indian Lac Cess (Amendment) Act, 1936 (IX of 1936), the Central Government are pleased to appoint MR. N. C. MEHTA, I.C.S., officiating Vice-Chairman, Imperial Council of Agricultural Research, to be the President of the Indian Lac Cess Committee and to be the Chairman of its Governing Body and Advisory Board, with effect from the 29th May 1937 (afternoon), *vice* SIR BRYCE BURT, Kt., C.I.E., M.B.E., B.Sc., I.A.S., resigned.

Imperial Agricultural Research Institute

MR. M. W. SAYER, B.A., I.A.S., Imperial Agriculturist and Joint Director, Imperial Agricultural Research Institute, New Delhi, has been granted leave for five months and 8 days with effect from the 28th May, 1937. From the same date :—

(i) DR. H. S. PRUTHI, M.Sc., Ph.D., Imperial Entomologist, has been appointed to officiate as Joint Director, Imperial Agricultural Research Institute, New Delhi, in addition to his own duties, and

(ii) MR. ARJUN SINGH MAN, L.Ag., Assistant Agriculturist has been appointed to hold charge, in addition to his own duties, of the current duties of the post of Imperial Agriculturist.

Imperial Veterinary Research Institute

MR. F. WARE, C.I.E., F.R.C.V.S., I.V.S., Director, Imperial Veterinary Research Institute, Mukteswar, has been granted leave for 8 months with effect from the 2nd July 1937, or subsequent date from which he avails himself of the leave.

CAPTAIN S. C. A. DATTA, B.Sc., M.R.C.V.S., Temporary Veterinary Research Officer-in-charge of Pathology, Imperial Veterinary Research Institute, has been appointed Veterinary Research Officer-in-charge of the Protozoological Section, Imperial Veterinary Research Institute, with effect from the 11th May 1937.

MR. T. J. HURLEY, M.R.C.V.S., D.V.S.M., I.V.S., Principal, Madras Veterinary College, has been appointed Veterinary Research Officer-in-charge of Pathology, Imperial Veterinary Research Institute, Mukteswar, with effect from the 11th May 1937, until further orders.

Madras

RAO BAHADUR D. ANANDA RAO, B.Sc. (Edin.), Director of Agriculture, has been granted leave from the 20th June 1937 or date of relief, preparatory to retirement on the 20th September 1937.

MR. P. H. RAMA REDDI, M.A., B.Sc. (Agri.), B.Sc. (Forestry) (Edin.), Vice-Principal, Agricultural College, Coimbatore, and now Secretary, Indian Central Cotton Committee, Bombay, has been appointed to act as Director of Agriculture, Madras, *vice* RAO BAHADUR D. ANANDA RAO, B.Sc., Director of Agriculture, granted leave preparatory to retirement.

RAO BAHADUR G. N. RANGASWAMI AYYANGAR, B.A., Millet Specialist, has been granted leave for four months with effect from the 25th June 1937 or date of relief.

MR. T. BUDHAVIDHEYA RAO, L.Ag., Deputy Director of Agriculture, Guntur, has been granted extension of leave for ten days in continuation of the leave already granted to him.

Bombay

The following appointments have been made in consequence of the reversion of RAO BAHADUR V. A. TAMHANE, M.Ag., M.Sc., from Sind :—

RAO BAHADUR V. A. TAMHANE, M.Ag., M.Sc., to be Deputy Director of Agriculture, Gujarat.

MR. G. P. PATIL, officiating Deputy Director of Agriculture, Gujarat to officiate as Divisional Superintendent of Agriculture, Deccan Canals

MR. V. M. CHAVAN, Assistant Professor of Botany, Agricultural College Poona, has been appointed to officiate as Economic Botanist to Government, *vic* MR. L. S. S. KUMAR, M.Sc. (Lond.), A.R.C.S., D.I.C., Economic Botanist to Government, proceeding on deputation.

Bengal

MR. M. Carbery, M.A., B.Sc., D.S.O., M.C., officiating Director of Agricul ture, Bengal, has been confirmed in that appointment with effect from the 16t January 1937.

MR. P. C. CHAUDHURI, Deputy Director of Agriculture, Eastern Circle, ha been appointed to act as Assistant Director of Agriculture, Bengal, *vice* MR. M CARBERY, appointed as Director of Agriculture, Bengal, or until further order

United Provinces

The services of MR. C. H. PARR, B.Sc., I.A.S., Deputy Director of Agricultur Bundelkhand Circle, Jhansi, were placed at the disposal of the Government of Bihar for the period from 19th to 27th March, 1937.

RAI SAHIB THAKUR RAMA PRASADA SINGH, Economic Botanist (Cotton an Rabi Cereals) to Government, United Provinces, Cawnpore, in the United Pro vinces Agricultural Service, Class I, has been granted leave for 8 months out of India, preparatory to retirement, with effect from 16th June 1937.

DR. B. L. SETHI, M.Sc., Ph.D. (Wales), Additional Economic Botanist (Cotton) to Government, United Provinces, has been appointed to officiate as Economic Botanist (Cotton and Rabi Cereals), *vice* RAI SAHIB THAKUR RAMA PRASADA SINGH, granted leave preparatory to retirement.

Punjab

KHAN SAHIB CHAUDHRI MOHAMMAD ABDULLAH, I.A.S., resumed charge of his appointment as Deputy Director of Agriculture, Hansi, on the 30th March 1937, relieving MR. H. G. SADIK, transferred.

DR. S. V. DESAI, B.Sc., Ph.D. (Lond.), D.I.C. (Lond.), Agricultural Bacteriologist, Lyallpur, has been granted leave for five months with effect from the 3rd May 1937.

MR. DURGA DAS, G.P.V.C., P.V.S., Assistant to the Professor of Medicine, Punjab Veterinary College, Lahore, has been appointed Officer-in-charge of the duties of the post of Professor of Medicine, Punjab Veterinary College, Lahore, in addition to his own duties with effect from 7th March 1937, *vice* MR. W. TAYLOR, M.R.C.V.S., D.V.H., I.V.S., deputed as officiating Director, Imperial Veterinary Research Institute, Mukteswar.

MR. F. B. HARROP, Poultry Expert, Gurdaspur, has been granted leave for four months with effect from the 15th June 1937.

Central Provinces and Berar

RAO SAHIB G. K. KELKAR, B.Ag., Deputy Director of Agriculture, has been permitted to return to duty before the expiry of the leave and has been posted to Southern Circle.

DR. R. J. KALAMKAR, officiating Deputy Director of Agriculture, on relief by RAO SAHIB G. K. KELKAR, B.Ag., has reverted as Assistant Director of Agriculture and remains attached to the office of the Director of Agriculture.

Bombay

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United Provinces

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DR. R. J. KALAMKAR, officiating Deputy Director of Agriculture, on relief by RAO SAHIB G. K. KELKAR, B.Ag., has reverted as Assistant Director of Agriculture and remains attached to the office of the Director of Agriculture.

MISS RAJUL RAOJEE BHAI SHAH, B.Ag., M.S. (Mich.), has been appointed as Horticulturist for research on citrus fruit on probation for a period of one year with effect from the 30th April 1937.

MR. G. D. MEHTA, B.Ag., Extra Assistant Director of Agriculture and Assistant Marketing Officer, Nagpur, has been appointed to officiate as Deputy Director of Agriculture, Economics and Marketing, in the Central Provinces and Berar Agricultural Service, Class I.

Assam

Mr. L. K. HANDIQUE, B.Sc. (Agri.) (Edin.), Marketing Officer, Assam, has been allowed leave for eight months out of India with effect from the 1st June 1937.

MR. GAJANAN PANDE, M.Sc., M.R.C.V.S., Veterinary Investigation Officer, Assam, has been allowed leave for one month with effect from the 15th June 1937.

Burma

The services of the following members of the Indian Agricultural Service have been placed at the disposal of the Government of Burma, from the 1st April 1937. They will form part of the Burma Agricultural Service (Class I) :—

(1) MR. J. CHARLTON, M.Sc., F.I.C.
(2) MR. A. MCLEAN, B.Sc.
(3) MR. F. D. ODELL, M.A.
(4) MR. H. F. ROBERTSON, B.Sc.
(5) MR. R. WATSON, N.D.A.
(6) MR. J. W. GRANT, M.A., B.Sc.
(7) MR. W. GREGSON, N.D.A.
(8) MR. D. RHIND, B.Sc.

MR. W. M. CLARK, M.B.E., B.Sc., Deputy Director of Agriculture, Northern Circle, Mandalay, has been granted leave for six months and fifteen days, with

effect from the 28th July 1937, or the subsequent date on which he avails himself of it.

U. THET SU, D.I.C., B.Ag., B.A.S., Class I, Mycologist, has been granted leave for two months and fourteen days with effect from the 17th April 1937.

The services of CAPTAIN S. R. RIPPON, M.R.C.V.S., I.V.S., of the Indian Veterinary Service, have been placed at the disposal of the Government of Burma from the 1st April 1937. Captain Rippon will form part of the Burma Veterinary Service, Class I.

Recent Publications of the Imperial Agricultural Bureaux

I. Obtainable from the Imperial Bureau of Soil Science, Rothamsted Experimental Station, Harpenden, Herts

Periodical Abstracts

	s.	d.
List of publications and papers on Soil Science published in the Empire Overseas in—		
1933	1	0
1934	1	0
Soil Research in the British Empire published in 1935	1	0
Lists of Publications relating to Soils and Fertilisers—		
Published monthly, per annum, post free	10	0
Monthly Letters—		
Free to recipients, within the British Empire, of "Publications relating to Soils and Fertilisers". Subscription, outside the Empire, per annum	4	0
Recent Developments in Soil Analysis—		
Quarterly Supplement to the above publications. Separate copies, each	0	6

Occasional Papers

	s.	d.
Technical Communications—		
34. Tropical Soils in relation to Tropical Crops	2	6
Annual Report : For the year 1933-34	0	6
" 1934-35	0	6
" 1935-36	0	6
Bibliographies—		
Bibliography on Coffee	2	0
Catalogue of Journals and Periodicals in the Library of Rothamsted Experimental Station	2	0
Special Publication—		
The Katamorphism of Igneous Rocks under Humid Tropical Conditions (by the late Sir J. B. Harrison)	5	0
Bibliography of Soil Science, Fertilizers and General Agronomy, 1931-34 .	25	0

II. Obtainable from the Imperial Bureau of Animal Health, Veterinary Research Laboratory, New Haw, Weybridge, Surrey

Abstracting Journal

	s.	d.
The Veterinary Bulletin—		
1931. Vol. 1. Quarterly (1st Number, April)	7	6
Annual subscription	20	0
Subsequent volumes. Monthly (1st Number, January)	5	0
Annual subscription (postage paid)	40	0

Indexing Publication

	s.	d.
Index Veterinarius.—Four issues a year. First issue, April 1933. Annual Subscription (postage paid). Volumes I to III mimeographed, Volume IV onwards printed	100	0

III. OBTAINABLE FROM THE IMPERIAL BUREAU OF ANIMAL NUTRITION, ROWETT RESEARCH INSTITUTE, BUCKSBURN, ABERDEEN

Journal

Nutrition Abstracts and Reviews. (Issued under the direction of the Imperial Agricultural Bureaux Council, the Medical Research Council and the Reid Library)—

Subscription per volume of 4 numbers	42	0
Per single number	13	0

Occasional Papers

Technical Communications—

6. The Composition of Certain African Foods and Feeding Stuffs	1	0
7. Wheat. Pre-eminence as a Cereal Food : Nutritive Value ; Relation to Health and Disease	1	0

Occasional Communications—

1. The Effect of Climate on the Composition of Pasture Plants	..	

IV. OBTAINABLE FROM THE IMPERIAL BUREAU OF PLANT GENETICS (FOR CROPS OTHER THAN HERBAGE), PLANT BREEDING INSTITUTE, SCHOOL OF AGRICULTURE, CAMBRIDGE

Journal

Plant Breeding Abstracts—

Quarterly. Annual subscription	15	0
Single copy	5	0

Occasional Papers

Indexes to Plant Breeding Abstracts—

Subject Index to Vols. I to V of Plant Breeding Abstracts	5	0
Subject Index to Vol. VI of Plant Breeding Abstract	2	6

Supplements to Plant Breeding Abstracts—

Summary of Reports received from Countries exclusive of the British Empire, 1928-31. Supplement I	2	6
Summary of Reports received from Stations in the British Empire, 1932-35. Supplement II	5	0

Technical Communications—

Vernalization and Phasic Development of Plants, 1935 (Joint Publication of the Imperial Bureaux of Plant Genetics)	10	0
The South American Potatoes and their Breeding Value	3	6

Bibliographical Monographs—

Breeding Resistant Varieties, 1930-33 (Supplement)	2	0
The Experimental Production of Haploids and Polyploids	5	0

V. Obtainable from the Imperial Bureau of Plant Genetics (Herbage Plants) Welsh Plant Breeding Station, Agricultural Buildings, Alexandra Road, Aberystwyth, Wales

	Journals	s.	d.
Herbage Abstracts—			
Quarterly. Annual subscription		15	0
Single number		5	0

Herbage Reviews—

Subscription is at present—Vol. 1 (1933), Vol. 2 (1934), Vol. 3 (1935), Vol. 4 (1936)—included in that to Herbage Abstracts.

Occasional Papers

Bulletins—

17. Vernalization and Phasic Development of Plants, 1935. (Joint publication of the Imperial Bureaux of Plant Genetics)	10	0

VI. Obtainable from the Imperial Bureau of Fruit Production, East Malling Research Station, East Malling, Kent

Journal

Horticultural Abstracts—

A quarterly abstract publication of current horticultural literature—

Annual subscription	15	0
Single copy	4	0

Technical Communications

7. Vegetative Propagation of Tropical and Sub-tropical Fruits, 1936. J. St. Clair Feilden and R. J. Garner	2	0
8. Horticultural Aspects of Woolly Aphis Control together with a Survey of the Literature, 1936. R. M. Greenslade	2	6

Occasional Papers

3. Annotated Bibliography on Bitter-Pit, 1934	1	6
4. Recent Work of Tropical and Sub-Tropical Interest	0	6

Other Publications—

Index to Volumes I-X of the *Journal of Pomology and Horticultural Science*, 1933. Compiled by Bureau, published by the Editors of the *Journal of Pomology and Horticultural Science*. Available from the Bureau	5	0
Old and New Standpoints on Senile Degeneration, 1931. A. P. C. Bijhouwer	0	6
Fruit Growing in the Empire. Standardisation of Horticultural Material with special reference to Rootstocks, 1927. R. G. Hatton. Being unnumbered Empire Marketing Board Publication. (Free).		
Viticultural Research, 1928. D. Akenhead. Being Empire Marketing Board Publication 11	1	0

VII. OBTAINABLE FROM THE IMPERIAL BUREAU OF ANIMAL GENETICS, INSTITUTE OF ANIMAL GENETICS, UNIVERSITY OF EDINBURGH, KING'S BUILDINGS, WEST MAINS ROAD, EDINBURGH

Journal

	s.	d.
Animal Breeding Abstracts (quarterly), commencing April, 1933. Annual subscription	15	0

Occasional Papers

	s.	d.
Bibliography of the Works of J. C. Ewart (free to subscribers of Animal Breeding Abstracts, Vol. 1), 1934	0	6
Animal Breeding in the British Empire. A Survey of Research and Experiment, 1934	2	0

VIII. OBTAINABLE FROM THE IMPERIAL BUREAU OF AGRICULTURAL PARASITOLOGY INSTITUTE OF AGRICULTURAL PARASITOLOGY, WINCHES FARM DRIVE, HATFIELD ROAD, ST. ALBANS, HERTS

Journal

	s.	d.
Bibliography of Helminthology. For the year 1933—		
Library Edition, bound in cloth	10	6
Stiff paper cover only	8	0
Helminthological Abstracts (1932 onwards). Issued in five or six parts per volume, each volume covering the literature of a single year. Subscription per volume, payable in advance	30	0
Completed volumes, bound in cloth	32	0

Occasional Papers

	s.	d.
(*i*) The Effects of some Natural Factors on the Second Ecdysis of Nematode Infective Larvae. G. Lapage	4	0
Notes and Memoranda—		
11. Recent Developments in the Control of *Heterodera marioni* . .	1	6

PUBLICATIONS ISSUED BY THE IMPERIAL INSTITUTE OF ENTOMOLOGY, 41 QUEEN'S GATE, LONDON, S. W. 7

Bulletin of Entomological Research—

Published quarterly, and containing original articles on Economic Entomology. Issued post free.

Annual subscription (payable in advance) 30 0

Review of Applied Entomology—

Consisting of abstracts or reviews of all current literature on Economic Entomology throughout the world. Published monthly in two series—

Series 'A' dealing with insect and other arthroped pests of cultivated plants, forest trees and stored products of animal and vegetable origin.

Series 'B' dealing with insects, ticks, etc., conveying disease or otherwise injurious to man and animals. Issued post free.

	Series 'A'	Series 'B'
Annual subscription (payable in advance)	30s.	15s.
Vol. XXIII (1935)	42s.	21s.

	s. d.
Zoological Record—Part Insecta—	
Published annually about July in each year and containing as complete a record as possible of the literature of the previous year, chiefly from the systematic standpoint.	
Annual subscription (including postage)	15 6
Report of the Fourth Imperial Entomological Conference, 19th—27th September, 1935	4 0

PUBLICATIONS OBTAINABLE FROM THE IMPERIAL MYCOLOGICAL INSTITUTE, KEW, SURREY

Journal

Review of Applied Mycology—	
Annual subscription, 12 monthly parts, with title-page and index (post free)	21 0
Single part	2 0
Title-page and index	3 0
Report on the Third Imperial Mycological Conference, 1934 . . .	2 0

Agriculture & Live-stock in India

Vol. VII, Part VI, November 1937

EDITORIAL

THE RUSSELL AND WRIGHT REPORTS

THE most important recent event for agricultural science in India has been the publication of the reports by Sir E. J. Russell and Dr. N. C. Wright. It will be recalled that last cold weather these two gentlemen, at the invitation of the Central Government, visited India in order to report on the work of the Imperial Council of Agricultural Research and to make recommendations for future. These reports were recently released and have attracted a considerable amount of attention.

Both reports are characterised by insight and realism. Sir John Russell goes straight for essentials when he says that the agricultural scientific services are set up with the double purpose of educating the cultivator so that he may better understand the natural forces with which he is dealing and of increasing his means of attacking the serious problems with which he is confronted. Throughout the whole of his report Sir John has before him the object of getting to the cultivator in as full and comprehensive a manner as possible the very valuable results of agricultural research. For this purpose he has recommended the widening of the Council's powers in order to bring within its scope what is now known as ' extension work '. For that purpose he recommends the creation of a Development Commission which will be a part of the Council and which will be in a position to plan and coordinate the important work of propaganda. There are various suggestions of detail in connection with extension work. He particularly recommends that workers on experiment stations should get outside their laboratories and even their experiment station fields and carry on simplified experimental work in cultivators' fields, wherever possible using a complete holding instead of a single plot.

Sir John's insistence on extension work does not, however, mean that he belittles agricultural research. Such an attitude would be unthinkable in one who is himself the head of the greatest agricultural research station in England. In connection with all the Council's researches Sir John Russell has something useful to say and we cannot go into details here. We may mention one or two directions in which Sir John indicates how things could be better done. For example, in connection with insect pests, Sir John Russell is of the opinion that what is now required is not so much the working out of life-histories but the study of the conditions in which attacks occur and die away. He is of opinion that a careful and continued study of conditions favourable and unfavourable to insect attacks may give the clue to ways of protecting crops by alterations of environmental conditions, such as changes in cultivation methods or planting dates. On the necessity of real scientific sampling for all types of research Sir John Russell is insistent and his advice has already borne fruit at the meeting of the Dry Farming Research Workers' Conference in Simla in September where, with the stimulating help of Professor Mahalanobis, standard methods of sampling for this important group of researches were agreed upon. Sir John is very keen that agricultural research work in India should be better known and recognised in other parts of the world. He recommends the writing up by competent workers of a series of monographs dealing with various types of Indian agricultural research up-to-date. This suggestion has already also begun to bear fruit in that it has been arranged that the work on wheat rusts carried on for so many years by Dr. K. C. Mehta will now be written up within the next two years. Sir John insists on increased productiveness as the main problem to which all others should be subordinated and regards the increased productiveness of improved varieties of grain crops as a means whereby land can be liberated for producing fruits, vegetables and fodder so that the glaring deficiencies of Indian diet may be remedied. He is also insistent on the need for the more intimate fusion of crop agriculture and live-stock husbandry. Sir John has many suggestions to make regarding the machinery required for putting his suggestions into action and for this reference should be made to the report itself which is easily available. Sir John recognises fully that the Council is the co-ordinating agency in agricultural research in India and that it has done its work well up-to-date.

From the outset it is evident that Dr. Wright has made good use of the facilities which were provided for forming his own opinions on the many problems with which he was presented. In general he approves of the lines along which animal husbandry development has been fostered by the Imperial Council of Agricultural Research but he is so impressed with the lack of co-ordination between the work of different Government Departments that he has devoted a special appendix to drawing attention to the need for co-ordination in rural develpoment, and particularly in regard to cattle-breeding and dairyng.

In his report he, moreover, gives it as his considered view that unification of live-stock improvement and veterinary work into a single department

of Animal Husbandry in each province or state will be essential for the successful development of cattle industry. This opinion has been arrived at after discussing the control of cattle improvement with Directors of Agriculture, Directors of Veterinary Services and Live-stock Experts as well as independent persons connected with cattle-breeding.

In discussing the development of dairying, he points out that 70 per cent of the people of India are dependent on the soil and 90 per cent live in rural areas so that the home market for dairy products is far more important than the export one. His view, therefore, is that a new technique is required and that indigenous products such as liquid milk, *ghee*, *khoa*, and *dahi*, which are an essential part of the diet of the people, should receive far more attention than products such as creamery butter, the consumption of which is almost negligible in comparison. He points out that the income derived by the producer from such products as *khoa* or *dahi* is often greater than from liquid milk, and that *ghee* production is of particular value because it leaves all the skim and buttermilk to be consumed in the village.

To develop dairying in India along sound lines, more facilities are needed for investigation and research to determine the best and most economical methods of producing and marketing indigenous commodities, and he emphasizes the urgency of providing a properly equipped dairy research institute in a suitable locality, within easy access of Delhi and Izatnagar. Proposals for the provision of such an Institute were submitted as long ago as 1932 but had to be abandoned owing to inability to secure the necessary funds.

Moreover, in order to help in finding the considerable sum of money required for such an Institute, he suggests that the special grant of Rs. 6 lakhs, which was sanctioned for an Experimental Creamery at Anand and for increasing the existing facilities at Bangalore, might be utilized for this purpose ; since he feels that if a properly staffed and equipped Dairy Institute were provided, the necessity for a separate experimental creamery need not arise at present. He considers that much of the work which was proposed at the Anand Creamery, namely systematic investigation into the processing, handling and transportation of liquid milk and dairy products and improved methods of manufacture of indigenous products such as *ghee*, *khoa*, *dahi* could be carried out at the Dairy Institute and that the question of utilizing the Anand Creamery as a sub-station might be held over until the new Research Institute has been satisfactorily established and preliminary experiments have been carried out on the various problems involved in dealing with liquid milk.

In regard to the necessity for increasing the output of milk he considers that, in view of the low purchasing power of the majority of the population, it is essential at the same time to effect all possible economies in the cost of production. He points out that the evolution of the dairy products which are peculiar to India is largely due to the fundamental difficulties involved

in handling milk under tropical conditions and the lack of adequate communications and transport facilities and that the following are the most important considerations to be taken into account in formulating a dairying technique for India :—

1. Attention should be concentrated on indigenous milk products, not on products of a western origin.
2. The main object should be to increase the supply of milk and milk products for consumption by the rural population.
3. Improved technique should be evolutionary rather than revolutionary.
4. Producers should be combined on a village industry basis ; and
5. Improvements in production should be supplemented by improved marketing facilities.

He also considers it essential that legal standards for the most important dairy products should be fixed, with a view to checking the adulteration which at present makes the development of a sound and economical supply of dairy products impracticable.

In regard to live-stock improvement, he is impressed with the figures which have been published in recent years by the Imperial Council of Agricultural Research as to the great milking capacity of Indian cows and suggests that the possibilities of mixed farming to increase soil fertility should be thoroughly investigated at Government farms and research institutes. In this connection, he feels that the potential value of cattle as a means of raising the fertility of the soil and thus increasing the output of both cash and fodder crops in India is incalculable.

In discussing live-stock improvement measures in detail, he draws particular attention to the paucity of the present provision, in most provinces, of suitable sires and to the urgency of taking effective measures to deal with the problem of scrub bulls.

For the improvement of milch cattle, he considers that the first necessity is to increase the all-round *per capita* milk yield of the indigenous breeds. Though a temporary increase may be obtained by crossing with imported breeds, he is thoroughly convinced that the right policy for India is to rely upon systematic selection of indigenous cattle. In that connection, he strongly approves of the measures which are being taken to establish central registration of milch cattle and milk recording, and draws attention to the need for paying more attention to the buffalo.

In regard to nutrition, he is impressed with the strikingly improved results which have been obtained by better feeding and management of Indian dairy cattle, and emphasizes the need for increased cultivation and better conservation of fodder crops, particularly leguminous crops such as berseem which improve fertility as well as milk yield. He is also impressed with the necessity for a thorough investigation of mineral deficiencies and in

this matter attaches particular importance to the investigation of nutritional deficiency diseases, which has recently been taken up by Veterinary Investigation Officers in collaboration with the Animal Nutrition Section at Izatnagar.

In regard to the development of dairying, he considers extension work most important and advises that in each province or state there should be an officer especially appointed to work in conjunction with the Central Dairy Institute and a Provincial Dairy Committee. He also advises that elementary dairy training and some research on local dairy problems should be carried out at provincial institutions such as Agricultural and Veterinary Colleges ; the Central Institute confining itself to more fundamental research and to the higher training of post-graduates.

He approves of the proposal to establish a Genetical Section at Izatnagar and considers that a considerable amount of genetical research is needed.

He agrees, however, that for the improvement of live-stock throughout the country, the first need is organized control in the villages and attaches great importance to the advantages to be gained by purchasing stud bulls from village breeders ; combined with systematic registration of progeny, early castration of unsuitable animals, and inoculation of improved stock against fatal diseases such as rinderpest. For such work, he considers it essential that the staff available should be greatly increased and approves strongly of the measures which are being taken to give suitable training to stockmen to supplement the numbers of Veterinary Assistants available. He also recommends that the fullest possible use should be made of agencies other than Government Farms for the improvement of live-stock for example Military Dairies, *pinjrapoles*, *gowshalas* and jails.

Finally, he is impressed with the great urgency of increasing the supply of specially grown fodder crops and improving the conservation of available fodder without which any measures taken for the improvement of live-stock must fail.

At the conclusion of the report, a great deal of information obtained from available records and statistical investigations is set out in a series of 46 tables. These are of the greatest value in giving an accurate bird's eye view of the problems which have been faced and should be carefully studied by every one interested in the development of dairying and animal husbandry in India.

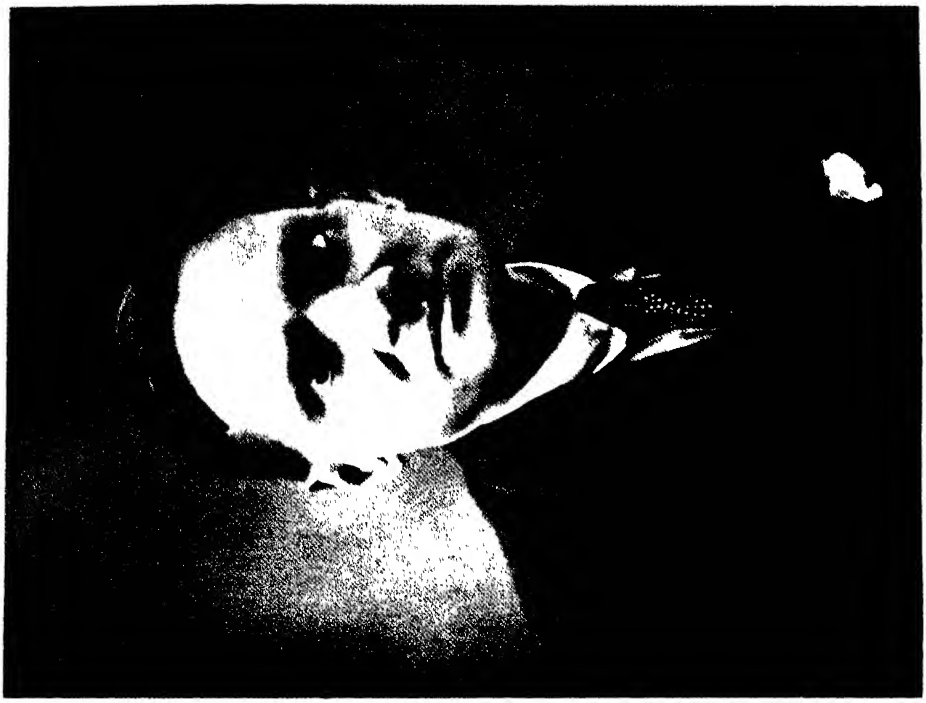
ORIGINAL ARTICLES

TWO DIRECTORS RETIRE

RAO BAHADUR D. ANANDA RAO GARU, B.Sc. (EDIN.)

ANOTHER of the first generation of agricultural officers in India has just retired, namely Rao Bahadur D. Ananda Rao Garu, Director of Agriculture, Madras. He was born at Masulipatam in the Kistna district on 20th September 1882, educated at Bezwada and Madras and after completing the diploma course in agriculture at the Agricultural College, Saidapet, proceeded to Edinburgh in March 1906 where he took the degree of B.Sc. in Agriculture in April 1909. After a special course in Dairying at Reading and after visiting important agricultural stations in England, he returned to Madras the same year. He joined the Madras Department of Agriculture on the 5th November 1909 as Assistant Director of Agriculture—the first of these posts created in the Province—and was posted to Bellary. In July 1914, he was appointed as the first Assistant Principal of the Agricultural College, a post newly created to meet the needs of teaching necessitated by the extention of courses of instruction. He was concerned mainly with teaching of Agriculture—theory and practice—and was responsible for placing the College Dairy on up-to-date lines. During this time he made many contributions on dairying matters. Till 1921, he continued to remain in the post, occasionally officiating as Professor of Agriculture and Superintendent of the Central Farm. He was promoted to the Indian Agricultural Service in January 1921 and confirmed three years later. From November 1920 to January 1922 he was Professor of Agriculture and Superintendent, Central Farm, Coimbatore. He was transferred to the districts as Deputy Director of Agriculture and posted to St. Thomas Mount in January 1922 where he remained in charge of the IV Circle till 1929. In the IV Circle much progress was made during that time in propaganda work when fairly large demonstration farms in the holdings of landlords were organised and run at a profit by adopting improved methods in agriculture for which land and money were provided by the landlords themselves. The results were published in the form of a bulletin of the Department. In 1926 Rao Bahadur Ananda Rao went on long leave to Europe and made a special study of rice cultivation in Italy. His observations on this tour were written up in the *Madras Agricultural Students' Journal*, November and December, 1927. He contributed several papers to this journal and also to the *Agricultural Journal of India* and the Madras Agricultural Yearbook. He was also responsible for various pamphlets and leaflets. In July 1928 he was conferred the title of 'Rao Bahadur' in appreciation of his services as Deputy Director.

PLATE XL



RAI BAHADUR J. N. CHAKRAVARTY, B. Sc., M. Sc., I. A. S.

RAO BAHADUR D. ANANDA RAO GARU, B. Sc. (Edin.)

In November 1929, he was transferred to Madras as Headquarters Deputy Director, a post newly created for assisting the Director of Agriculture. He was the propaganda officer of the Department during which time the whole presidency was visited and a plan of co-ordination between various circles of the presidency was drawn up. From May 1931 to February 1932 he was placed in charge of the Department, reverting as Headquarters Deputy Director. In September 1931, he was promoted to the Selection Grade. In 1934, he officiated as Director of Agriculture for six months at the end of which he was transferred to Coimbatore as Principal of the College. In June 1935, he was permanently appointed as Director of Agriculture in which post he has continued till his retirement this year.

During the short period of his Directorship there was general progress in research activities at the College and in the districts.

Rao Bahadur Ananda Rao is well known to the many departmental colleagues and non-official members whom he met at the various meetings of the Imperial Council of Agricultural Research, the Board of Agriculture and Animal Husbandry, and the Indian Central Cotton Committee. On all these bodies he set forth the case for Madras schemes and added his counsel on matters of general policy with clearness and modesty. The goodwill of all follows this genial Director, to whom we wish prosperity in his well-earned retirement. [W. B.]

RAI BAHADUR J. N. CHAKRAVARTY, B.Sc., M.Sc., I.A.S.

RAI BAHADUR J. N. CHAKRAVARTY, Director of Agriculture, Assam, who has just gone on leave preparatory to retirement, was born in January 1882. He was originally educated in the University of Calcutta. After having graduated in science and having obtained the Diploma of Agriculture from the agricultural section of the Bengal Engineering College—the only institution of its kind then existing in Bengal—he was in 1905 sent by the Government of Bengal to the University of Cornell, U. S. A., for higher agricultural education. He returned to India towards the end of 1907 after having obtained the degree of Master of Science in Agriculture and joined the Agricultural Department of 'Eastern Bengal and Assam' as a Superintendent. The Department of Agriculture, as we now know it, had only been recently organised by Lord Curzon. The Pusa Institute had just started and there Mr. Chakravarty underwent a further course of practical training for a few months. He served in the provinces of 'Eastern Bengal and Assam' and Bengal till 1919 and his most important work during this period was the organisation of the Dacca Central Farm and the Rangpur Cattle Farm. He was promoted to the Indian Agricultural Service in 1919 and was appointed as a Deputy Director of Agriculture in Assam. Throughout that province he organised agricultural demonstration work on modern lines. In Assam the post of the Director of Agriculture was combined with that of the Director of Land Records and Registrar of Co-operative Societies till 1930. When Agriculture was organised as a separate department in 1930, Rai Bahadur Chakravarty was selected to officiate as the Director of Agriculture and was the first technical officer to

hold such a post in Assam. The Department of Agriculture saw great developments during his regime. As a recognition of his meritorious services, the title of Rai Bahadur was conferred on him at the time of the Coronation of His Majesty King George the Sixth. Although he was due to retire in January 1937, his services were retained till the end of August in view of the change of Government.

Dr. S. K. Mitra, Ph.D., Economic Botanist, has succeeded him.

Rai Bahadur Chakravarty's small spare figure and vivid eyes will be missed at the meetings of the Imperial Council of Agricultural Research. He could plead the cause of his province well, and his opinion on matters of general policy was sound and given without ostentation. In addition to his agricultural work he has been deeply interested in organisations for social and educational improvement, and it is certain that they will continue to receive even more help and attention in his well-merited retirement. [W. B.]

JUDGING CATTLE

BY

R. W. LITTLEWOOD, N.D.A., I.A.S.

Deputy Director of Agriculture, Live-stock, Hosur Cattle Farm P. O.

In judging live-stock there are two faculties which require special development—observation and judgment.

The eye must see quickly and accurately, so that there may be no mistake in the observations which are to form the basis for a conclusion. Whilst this is to a considerable extent dependent on being informed on what to look for, no amount of information will supply keen powers of observation which have to be specially developed and kept in practice by continuous use. The student of live-stock judging should ever be on his guard and never allow himself to be misled into thinking that he sees things which he does not, for if that occurs, the foundation for candid criticism will be built on sand. It is better to be simple and completely candid with one's observations than to be in the least deceptive or dilatory in recording them.

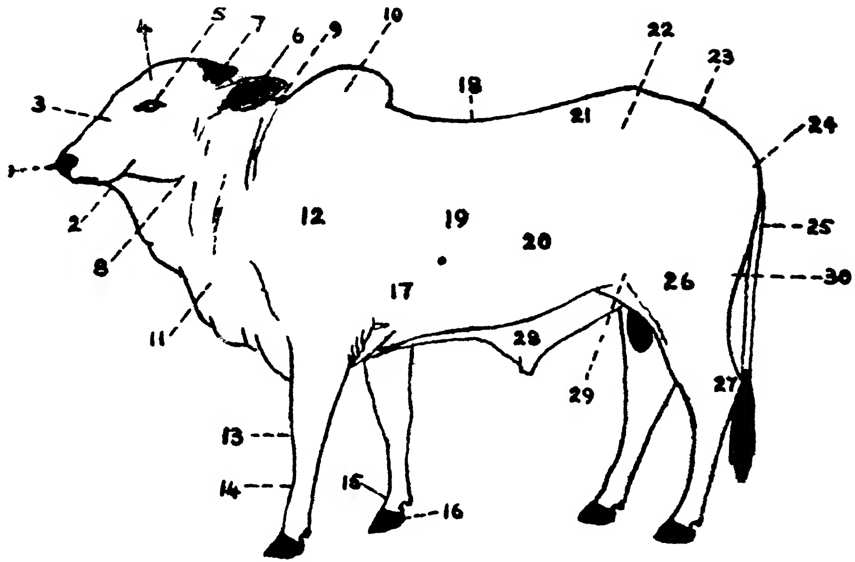
Not only should one be quick to see things as they really are but there should be as much despatch in detecting deviations from the correct standard. There is much difficulty in this for a standard only forms itself clearly in one's mind after the results of experience, observation and study have merged together into a clearly defined ideal. To formulate an ideal is absolutely essential and in doing this, it is imperative to familiarise oneself with the good qualities of animal life, correct conformation and the highest types, so that the least variation from these at once attracts the attention. When a distinct ideal based on the best types and their highest qualities has been formed in the mind, and this is supported by a discriminating eye, it is but another step to render a correct judgment.

In show ring judging, after the inspection is complete, a 'short leet' is made of the likely winners of place from the rest of the competitors. Upto this time the judging has been the detection of faults and deviations from the standard required, but now the work is more of the nature of comparative judging in which the points of the animals which are considered worthy of prizes are compared to determine their rank. It greatly aids despatch and tends to more exactness to make such a selection where there are six or more animals in the class. It also materially assists the judge to keep in mind the qualities which he must compare. Carefulness at this point will do much towards the formation of a decision, which may be afterwards maintained with justice.

JUDGING A BULL—DRAUGHT TYPE OR A WORK-BULLOCK

It is necessary that the animal stands on a level surface, if possible, and stands naturally and is not held so as to hide any natural defects which otherwise would be easily seen. In moving towards the animal from in front, note the characteristics of the head and neck quickly and then placing the hand upon the hump and using the tips of the fingers feel the compactness of the shoulder, its covering and the smoothness with which it fits to the body. After handling the back carefully, the covering of the ribs should also be observed very closely. For determining the quality of the flesh it is a good method to gently push the ends of the fingers between the ribs. If there is no natural flesh or muscle there, the ends of the fingers are easily inserted in this region but if the covering is of the best quality and it is mostly muscle, the ends of the fingers cannot be inserted very far between the ribs. To estimate the character of the skin and the mellowness of the flesh, the skin is generally lifted between the first finger and the thum and its quality carefully noted. Then with the fingers flat, gentle pressure against the ribs reveals the mellowness or firmness of the flesh. The thickness of the loin is an important point. The fulness and characteristics of the hind quarter are observed, then the fulness of the flank. By standing squarely behind it, the development of the hind quarter is noted ; after this the other side may be seen in a similar manner. It is generally accepted that most of the power of a draught animal resides in the hind parts, this is the propelling power and so the hind quarters should be well covered with strong muscle, the fulness of the thigh and quarters are due to a large degree to the extra development of muscle in these parts. It is as well to remember that power rather than speed is required in a draught animal. The size of the muscle has more to do with power, while the length of the muscle is indicative principally of speed. Of all the desirable features to be sought in a draught animal, that of strong, clean and firm bone and good feet are two of the most important. The working pace of the bullock is the walk and it is very essential to pay particular care to this. In criticising the walk, the action should be noted from three points of view—before, behind and from the side. In approaching, the animal should carry its head well and the stride should be regular, the feet should be lifted clear of the ground and placed down evenly as if in deliberation, the toes must not point outward but straight forward. From the side, it may be noted if the hind and fore legs work in unison. Animals with short backs show up better in action from the side view whereas those with long backs and weak loins appear to drag their legs in a slovenly fashion. Viewed from the rear, the action of the hock should be carefully noted. The flexion in this region should be free and straight. Some hocks are turned outward, some inward and the feet are thrown out of line, others are almost straight or too curved. As a rule the stride should be long and well balanced with a free movement.

1 Muzzle
2 Jaw
3 Face
4 Forehead
5 Eye
6 Ear
7 Horn
8 Throat
9 Neck
10 Hump
11 Dewlap
12 Shoulder
13 Knee
14 Cannon
15 Pastern
16 Hoof
17 Chest
18 Back
19 Ribs
20 Barrel
21 Loin
22 Hip
23 Croup
24 Buttock (pin bone)
25 Tail
26 Thigh
27 Hock
28 Sheath
29 Flank
30 Quarter



Location of points of a bull

Fig 1.

Head.—This differs with various breeds but it should not be coarse. There should be sufficient breadth between the eyes and the head should not be too long but proportionate to the rest of the body. It should be well set on the neck. The nostrils should be large. The eyes should be large and prominent yet placid. The ears should be long, pointed and alert, neatly attached to the head and covered inside and on the edge with fine silky hair. Horns should be of fine texture, not coarse and no tendency to split.

Neck.—This should be strong and of fair length.

Shoulders.—Should be full and strong and be sloping and muscular. A moderately oblique shoulder favours a long quick step. When a shoulder is too upright it forces the step to be short and slow. Activity and elasticity of movement is a desirable feature in a good bullock.

Chest.—This should be deep and comparatively broad providing plenty of lung room. It is best estimated by the girth which is the circumference of the body immediately behind the hump and forelegs.

Forelegs.—The forearms should be well covered with muscle. Legs should be straight. When viewing the fore limbs from the front a vertical line downward from the point of the shoulder should fall upon the centre of the knee, cannon, pastern and foot. When viewing from the side a vertical line from the centre of the elbow joint should fall upon the centre of the knee and pastern joints and back of the foot and a vertical line drawn downward from the middle of the arm should fall upon the centre of the foot.

Feet.—Should be hard and the two halves of the hoof even and the cleft not too wide ; black in colour and a waxy appearance.

Body.—Short, broad back and deep ribs. If the body is not round and the ribs well sprung and deep, the chest is likely to be narrow.

Loin.—Thick and broad.

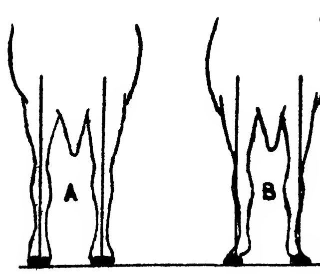
Croup.—Fairly broad and well muscled. In some breeds the croup has an extreme slope whereas in others it is nearly straight. The strength of the croup is not generally judged by the slope but the degree to which it is muscled. It should not slope too much.

Hind quarters.—Thighs should be well muscled and the quarters fairly full ; hips not too wide apart.

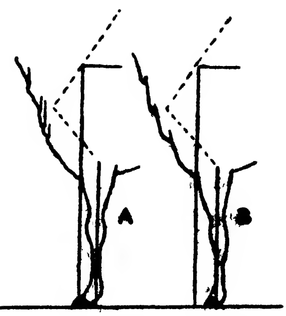
Hocks.—Should be fairly wide, defined and properly set. When viewing the hind limbs from the side a vertical line drawn downward from the hip joint should fall upon the centre of the foot and a vertical line drawn from the buttock should coincide with the angle of the hock and pastern joints. When viewed from the rear, a vertical line drawn from the point of the buttock should fall upon the centre of the hock, cannon, pastern and foot.

Skin and hair.—Skin should be black in colour, soft and mellow and the hair fine.

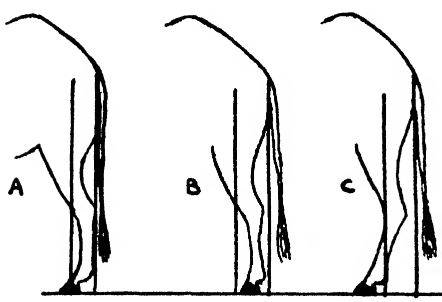
Tail.—Thin, well set on, long and tapering finely to the switch ; switch should be full and black in colour.



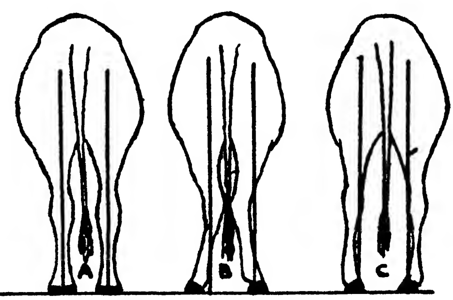
Front view of fore limbs.
A : the right conformation.
B and C : common defects.



Side view of fore limbs.
A : the right conformation.
B : common defect (knockkneed).



Side view of hind limbs.
A : the right conformation.
B and C : common defects.



Rear view of hind limbs.
A : the right conformation.
B and C : common defects.

FIG. 2.

JUDGING A DAIRY COW

To estimate the merits of dairy cows when in milk there is no method so satisfactory as the actual records made with the "Gerber Test" and the herd recorder (scales). Having the weight of milk yielded, the percentage of fat in it, duration of the lactation period and the dry period together with the amount of food consumed, the merit of a cow for dairy purposes may be valued fairly accurately. Even all these details do not completely express all the good qualities that a dairy cow should possess ; for the breeder has in mind other qualities that he desires, chief among which may be mentioned the ability of the cow to produce calves of the merit of herself and to continue doing this for a number of years.

In some of the leading Dairy Shows the basis for making awards in a two-day test are :—

Twenty points for constitution and conformation.

One point for each pound of milk.

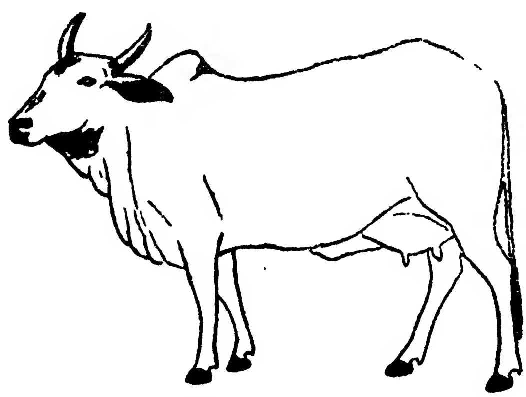
Twenty points for each pound of fat.

Four points for each pound of solids not fat.

One point for each ten days (limit 200 days).

Ten points are deducted from the total score for each per cent of fat below three per cent fat in the milk.

While the judging of dairy cattle by points may not be completely satisfactory, it is a quick method for use in the show ring and it assists in the study of the many traits that are common to dairy cattle. Its value does not lie in the degree to which it assists in distinguishing the good cows from the bad ones but chiefly for the insight which it gives into the nature and functions of the dairy animal, and it is the deeper knowledge of them that leads to better care, more intelligent feeding and more successful breeding, which all culminate in greater production.



Dairy type (Scind)
FIG. 3.

If we consider a cow simply as a machine for making milk, we find that the food is manufactured into blood by the stomach and its accessories and the blood in a general sense is made into milk by the udder so that the two main manufacturing centres of the dairy cow are the stomach and the udder and it is around these that what are known as the characteristics of the dairy type have been evolved. But as the dairy cow is more than a machine, as she has vitality and recuperative power, we find that the nervous system as expressed in the nervous temperament is what enables her to maintain her enormous productive powers in these centres.

Generally when reference is made to an animal having a nervous temperament it is commonly supposed to mean that it is irritable and excitable which actually indicates the lack of nervous control. The term as properly used in reference to dairy cattle means an animal that is full of nerves, one that has strong nerves which give tone to the various organs of the body. The animal of nervous temperament is one that is sensitive and active giving all regions the greatest vitality and all the organs the greatest productive powers.

When a dairy cow is performing her function, there are four centres of activity ; the digestive system, the milk secreting system, the circulatory system and the nervous system and it is because of extreme activity in these centres that the dairy cow inclines towards a given type ; she tends to become wedge-shaped and lean because of the unusual activity in the regions mentioned. Certain portions of her body have an undue amount of work and these develop in an extreme degree, while other portions, because of their activity and lack of nourishment, do not develop to the fullest degree ; this results in a type that is inclined to be narrow in front and wide and deep behind. While it does not necessarily follow that a cow, to be a good dairy animal, must be of this type, yet, because of the work she does, most of them tend towards it. A cow of good dairy qualities, when she is milking freely, is likely to leave a lean appearance over every region of her body showing that she is an animal of nervous organisation and further that she utilises all her food for the production of milk and not for the putting on of flesh.

The points to notice in selecting an animal are the general appearance denoting constitution and milking qualities and the conformity to type which is noticeable in all well-bred animals, secondly the shape and capacity of the udder and the size of milk veins and teats, thirdly the general indications of suitability for dairy purposes.

The ideal cow should be wedge-shaped, the side lines tapering from the hind quarters towards the neck. The cow should have a feminine and docile look, neck should not be thick, the head should be fine and face long and lean. The eye should be full, mild and bright and more or less active. A quiet disposition is reflected by a mild eye, while one that is bright is indicative of vigorous circulation and good health. Large dilated nostrils permitting easy access of air to the lungs are usually associated with depth of chest and lung capacity. The skin should be thin and silky to the touch and feel oily. It is noticeable that animals with fairly large dewlaps hanging in folds covered with fine silky hair are generally good milkers. The hair covering all the body should be short, soft and fine. The udder should be covered with fine silky hair. The ears should be fairly long, of fine quality and covered inside with fine silky hair. There is a saying in India that if a cow cannot flap its eyes with its ears, it is not of much use. The horns should be small and fine. The neck should be fine, a thick neck gives a masculine

appearance and is generally a beefy type. The hump should not be too fleshy or big and the shoulders tight and oblique. The barrel should be deep and large, the ribs should be long and well sprung. This denotes good lung capacity. The backbone should be prominent and strong and the back lean. The hip bones should be prominent and wide apart and almost level with the back, the rump long and wide. From the point of the hip to the tail head, there should be a marked hollow or sinkage, due to the absence of flesh, a condition characteristic of heavy performers when in full milk. The thighs should be long and lean and the flanks thin, the tail should be well set on, fine and tapering, reaching down well below the hocks and carrying a good switch. The hocks should be wide apart and set square with plenty of room allowed for the udder. The udder should be full and capacious but not fleshy, and attached high, while the fore-quarters should extend far forward, it should be silky to the touch, flat underneath and well rounded behind, each quarter being sound and the teats easy to draw. Length in the udder is important as it gives a long line of absorption. The udder not only secretes milk from the blood but it is also a receptacle for holding the milk. The teats should be evenly placed, of suitable size and squarely set on. Milk veins should be large and branched. When empty, the udder should nearly lose its form and appear to consist of folds of soft, pliable and elastic skin.

The 'touch' which is best judged by taking hold of a portion of the skin and flesh behind the last rib, should be 'mellow', the skin loose and rather thin and of a slightly oily nature and the hair soft and velvety. The skin should not be dry. The cow should present an alert but docile appearance. Generally speaking, a good dairy cow possesses a loosely knit frame. As a rule milking cows should not be coarse or heavy.

PLATE XLI

FIG. 1. Sugarcane stem opened to show a caterpillar boring inside it (original)

FIG. 2. A small parasitic wasp laying its egg by means of a piercing ovipositor, through the rind, on a boring caterpillar inside a sugarcane stem (original)

THE BIOLOGICAL CONTROL OF INSECT PESTS*

BY

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Introduction

Since the time man started to raise crops the problem of insect pests injuring crops and stored produce has engaged his attention. At the present stage of human civilisation the control of harmful insects rests on a combination of methods which may be classified as mechanical, cultural, chemical, legislative and biological. The last-mentioned method, that is, the biological, has developed and is developing extensively due to the realisation that nature tends to maintain a balance of various forms of life and that very often insects and plants are checked in their multiplication by natural enemies. The most important natural enemies are the parasitic and predacious forms of life of which insects are an important group. Insects which keep down weeds and other insects injurious to human welfare thus deserve the title of 'beneficial insects'.

For its prevalence and abundance every organism depends on favourable conditions regarding climate, weather, availability of food and shelter. When civilised man cultivates crops or keeps herds of domestic animals for the increased quantities of the vegetable and animal products he derives from them he is assuring an abundance of food for the organisms that feed on the plants and animals he is interested in. Beyond this when man colonizes new countries he often introduces new plants and new animals into new areas. With these he often introduces pests without the beneficial insects that kept them in check in their original homes. As a result the pest thrives in the new country under favourable conditions of climate and food supply and absence of natural enemies.

Early history of biological control

The earliest written record of biological control is in the year 1775, and deals with the use in Arabia of predatory ants from mountainous areas, brought down and placed on date palms to control other ants which often destroyed these trees. It was in 1873 that the first international transport of a beneficial insect was made. This was the introduction from America to France of a predatory mite, *Rhyzoglyphus phylloxeræ* Riley, which feeds upon and checks the Grape Vine Phylloxera, a

*This is the eighth of a series of popular articles for practical farmers on various agricultural subjects of general interest.

sucking insect. Biological control became famous in 1889 with the great success that resulted from the importation of the predatory Lady-bird Beetle, ***Rodolia cardinalis*** Muls., from Australia into California to control the Cottony Cushion Scale Insect, *Icerya purchasi* Mask., which was doing great harm to citrus trees following the introduction of the pest into California from Australia.

The basis of biological control

In nature every organism exhibits an inherent power to live and multiply. The power that a species possesses to propagate itself under optimum conditions is known as its Biotic Potential. The forces that are exerted from external sources to keep down its number form the Environmental Resistance.

The Biotic Potential is controlled in any species by its ability for reproduction. The ability for reproduction depends on the number of young produced, sex ratio in the young and the individual's power to find food and protection. In Environmental Resistance there are two sets of factors—physical and biotic. The main physical factors are light, temperature and moisture. The biotic factors are those forces exerted by organisms playing the part of competitors for food, space and shelter and of predators and parasites.

Predators and parasites are the natural enemies of living things. Predators are organisms which attack and forthwith feed on other organisms sometimes with fatal effect. Parasites are living things which show a constant or casual association with and dependence on certain other organisms which are therefore called their hosts and on which they have to rely for sustenance by feeding slowly and gradually on them while settled in or on them. Examples of predators are Lady-bird Beetles and larvæ feeding on plant-lice, bats eating insects, Dragon Flies which catch small insects for food and the preying mantis which sits on foliage and flowers to catch and eat the insects that come near them. Ant-lion larvæ which hide in the ground below funnel-shaped depressions in sandy or dusty ground and attack and devour small insects that come to the pits and spiders which catch insects in their webs are predators. Mosquitoes and sand-flies are predators. The blood-sucking lice found on man, mites found in itches, ticks on cattle, Tachinid flies which breed in caterpillars, and the malaria organisms in man are all parasites. Many insects are parasitic or predatory on other insects, so much so that it has been said " It is a mighty good thing that insects fight so much among themselves, otherwise they would overwhelm us ".

Some parasites and predators

Parasites completely or partially consume the organisms on which they are dependent for food. The organisms are known as hosts. When a parasite remains on the outside of the host it is called an ectoparasite. If the parasite lives inside the host it is known as an endoparasite. A parasite which has as

host a non-parasitic organism is a primary parasite. A parasite which attacks another parasite is a secondary parasite.

Many kinds of organisms have been tried as means for controlling insect pests and there exist many parasites and predators whose capacity to help man to check pests have not yet been experimentally studied or even observed. Such beneficial organisms are found even among the lowest forms of life. First of all these are the disease-causing micro-organisms like bacteria, fungi, viruses and protozoa. Many fatal insect diseases are caused by these. The isolation of the causative organisms, their cultivation and identification require special knowledge. Their usefulness as control agents requires exact knowledge of the stage of the insect pests when infestation can take place and the environmental conditions necessary for producing an artificial epidemic. Above these organisms come the roundworms which are parasitic. Next there are the insects. Adult insects have different feeding habits and some are predators. In their immature state many insects are parasitic or predatory. The groups of insects which contain parasites are beetles (Coleoptera), moths and butterflies (Lepidoptera), flies (Diptera), and bees and wasps (Hymenoptera), the two last groups containing a great many species and several of proved importance in biological control. The groups of insects which have predatory species are preying mantises and their allies (Orthoptera), bugs (Hemiptera), beetles (Coleoptera), flies (Diptera), and bees and wasps (Hymenoptera). Closely allied to the insects are the spiders, scor pions, ticks and mites many of which are predatory. A few of them are parasitic. Above these there are the vertebrates some of which are predacious having either carnivorous or insectivorous habits, the important groups being the fishes, amphibians, reptiles, birds and mammals.

Some attempts in biological control

The introduction in 1889 of *Rodolia cardinalis* Muls., into California to control the Cottony Cushion Scale has already been mentioned. This beetle was later introduced into South Africa, Portugal, Italy, France, New Zealand and Hawaii and other places to help the orange and lemon growers against the same pest as in California and good results have been obtained.

In Hawaii the sugarcane industry was suffering great loss because of a leaf-hopper, *Perkinsiella saccharicida* Kirk., introduced from Australia. This pest sucked the juice from canes and leaves. Search was made in Oriental and Australian regions for natural enemies of this pest, and by the introduction of a predatory bug, *Cyrtorhinus mundulus* Bredd., from Australia, the leaf-hopper was brought under control.

Some twenty years ago when the Italian silk industry became almost impossible because a scale insect, *Diaspis pentagona* Targ., was damaging the mulberry trees, a parasite of this scale, *Porspaltella berlesi* How., was introduced from the United States and it successfully multiplied and kept down the scale insects and the mulberry trees were saved.

In Fiji since 1877 the coconut palms had been damaged by the leaf-eating caterpillar of the moth *Levuana iridescens* Beth—Baker. In 1924 when the pest reached very serious proportions and it was almost impossible to grow coconut palms a search was made for beneficial insects in different countries. The Tachinid fly, *Ptychomyia remota* Ald., found in the Federated Malay States as a parasite of a related caterpillar, was introduced into Fiji. The parasite readily made the Levuana caterpillar pest its host and has established itself in the islands as an effective check on it.

In all the above cases the aim was to introduce a beneficial insect from a foreign country in the hope that it would establish itself and become a control on some serious pest. Besides this, another line of biological control has been attempted. This is to breed suitable 'indigenous' parasites and predators in large numbers and liberate them in areas where their hosts were pests. In Russia in 1913 it was shown that by artificial rearing on certain host insects the small parasitic wasp *Trichogramma* could be produced in large numbers and kept ready for distribution to check certain pests. Today *Trichogramma* is bred artificially in many countries and supplies of it are maintained for purchase. Many farmers who require them when troubled by pests, chiefly certain sugarcane borers, which this parasite attacks, get them by post and distribute them periodically in their plantations.

There are several insectaries now in the United States of America and Canada for propagating and distributing beneficial insects and millions of dollars are saved annually by biological control work in these countries. Both countries have also placed on a sound and economical basis the activities necessary for the world-wide search for beneficial insects and their importation, multiplication and field colonization.

Some problems relating to the biological control of native and introduced pests

It was once assumed that a given species of beneficial insect had a fixed effect in its controlling power over the host it attacks. It is now established that the same beneficial insect may have different strains and show different reactions to its hosts under different environmental conditions. *Tiphia popilliavora* Roh., a parasite of the Japanese beetle, *Popillia japonica* Newm., has been collected in Korea and Japan and the two strains showed a marked difference in reproductive capacity. Their times of emergence too are different. Therefore supplies of parasites have to be obtained from different regions within its total range to secure the most effective strain for biological control purposes.

Because the great number of successful instances of biological control by imported parasites or predators are from insular areas like Hawaii and Fiji and West Indies there is an impression that biological control cannot succeed in continental areas. But the real limiting factor is climate. Where the climate is mild enough for insect pests to reproduce uninterrupted by extreme heat or extreme cold

there is the maximum opportunity for beneficial insects to establish themselves and to be effective. Islands, owing to the influence of the sea, have their climatic conditions tempered. Cases of successful biological control are to be seen in both tropical and sub-tropical islands and also in sections in continental areas where the climate is mild. It should also be remembered that compared to islands continents show a greater variation of climatic and topographic conditions and in the number and distribution of plants and animals. One beneficial insect cannot, therefore, be expected to be equally effective over an entire continent. There will be certain environments where it will be effective whereas in certain others it will not succeed. Biological control has succeeded in California, Italy and parts of Australia. The reason is that these areas are ecological islands. Though not having a definite all-round sea barrier they have barriers in the shape of large sheets of water, mountains and deserts. Therefore, the argument that biological control has no hope in continents or in the peninsula of India has no weight.

Another argument in favour of biological control in India is that besides the successful introduction of foreign parasites and predators there has been success in continental regions by the transfer of native beneficial insects from one section of the country to another. In Canada in 1916 the predacious mite, *Hemisarcoptes mali*, was introduced from New Brunswick to British Columbia, that is, from the East Coast to the West Coast, over two thousand miles, and it became a definite check on the pest, the Oyster-shell Scale, *Lepidosaphes pinnaeformis*. Again in 1919 a Tachinid parasite, *Blepharipeza leucophrys*, was transferred from British Columbia on the West Coast to the province of Alberta, in the interior, over a distance of about five hundred miles and it successfully reduced the number of the Tent-caterpillar, *Malacosma* sp.

There are instances where pest control has been achieved by the mass production of a local beneficial insect and its large-scale release when and where required. The most famous example of this method of biological control is the use of the minute egg-parasite, *Trichogramma minutum* Riley. Many contend that the artificial aid to increase the number of a native parasite does not increase its usefulness. But in Louisiana and in Barbados definite success has resulted by the release of *Trichogramma minutum* Riley, to keep down the Sugarcane Moth Borer, *Diatraea saccharalis* Fabr. This parasite occurs in India and is known to have as its hosts in India the Sugarcane Top-borer, *Scirpophaga nivella* F., the Sugarcane Stem-borer, *Diatraea venosata* Wlk. and *D. sticticraspis* Hmpsn. and the Sugarcane Root-borer, *Emmalocera depressella* Swinh. In Mysore the use of this beneficial insect against sugarcane borers has been claimed to be successful. The author this year released these parasites in a sugarcane field in Cuttack and compared to a check plot where no *Trichogramma minutum* Riley. was released, the experimental plot has already shown a remarkably low number of shoots killed by the borers.

It is also supposed that insects when introduced without their natural enemies into new countries have opportunities for great increase and that the introduction

of beneficial insects to check such insect pests may result in control but that pests of indigenous origin are not affected by biological control measures. Against this it must be stated that the expansion of pests over continental tracts due to human agency will often make it possible to use with advantage human ingenuity to increase and spread and maintain their natural enemies. Also where extremes of climate make hibernation and aestivation necessary and consequent handicaps slow down natural reproduction and when inclemencies of the weather or other natural catastrophies reduce the population of beneficial insects it is possible by human intervention to make up for such losses and to control the pests by artificial mass production and liberation of the beneficial insects or by the introduction of strains of parasites and predators which have greater capacity to overcome local unfavourable conditions. The relationship between an indigenous insect and its native parasites and predators and the factors that influence this relationship and cause their populations to fluctuate have in no instance been thoroughly studied. Therefore only actual experiment can reveal the possibilities of using any native parasite or predator for the control of native pests and for maintaining a balance favourable to man and different from the equilibrium brought about by forces working through a great length of time. The woolly aphis, *Eriosoma lanigerum* Hausm., has been a pest of apple trees in many European and other countries. It has been effectively controlled in its original home in Europe and in other places by the introduction of *Aphelinus mali* Hald., an internal parasite which is a native of North America. It has been proved, however, that potential outbreaks of indigenous pests can be economically averted by the artificial increase of native beneficial insects at the right time. Examples of this are the use, in America, of the parasite *Trichogramma minutum* against the Sugarcane Borer, *Diatraea saccharalis* Fabr., the European Corn Borer, *Pyrausta nubilalis* Hbn., and the Codling Moth of apple, *Carpocapsa pomonella* L., and in Java of the parasite *Encarsia flavoscutellum* Zehnt, to check the Sugarcane Woolly Aphis, *Oregma lanigera* Zehnt.

The introduction of parasites and predators

When an introduction of beneficial insects is to be attempted the essential point to remember is that no two localities are alike and biological control problems though looking similar in many ways cannot be handled in the same manner in different places.

When definite action is to be taken for the introduction of parasites and predators against a pest the first step is to know what the pest is and to know all that is recorded about its geographical distribution. Insects closely allied to it also should be studied for their distribution. Then, in localities where the pest is found under closely related physical conditions and still does not multiply into pest proportions, search should be made for parasites and predators. If necessary, the parasites and predators of insects closely allied to the pest should also be looked for in other areas where physical conditions are like those in the home country of

the pest. Next, such parasites and predators should be identified and their habits should be studied.

In choosing beneficial insects for introduction the good points to look for in them are (1) ability to outnumber the pest, (2) specificity, (3) ability to adapt itself to the new physical environment, and (5) ability to distribute itself into wider areas from the place of introduction.

For actual release in the field the beneficial insects should be available in large numbers. There are two ways of securing the large numbers required, one is to breed them artificially from a few collected in the field and the other is to collect large numbers from its home land. Artificial mass production is very desirable as this ensures uncontaminated supply at the best time for their release.

Care is necessary regarding the transport of these beneficial insects. Suitable packing and rapid transport under favourable conditions should be arranged. Foreign introductions should be carefully examined and studied in insect-proof laboratories. Cold storage chambers are often necessary to keep the insects under experiment, in dormant condition, when required. For each species under study suitable rearing methods will have to be devised and releases have to be made in suitable areas of a sufficient number of individuals. Sometimes it will be necessary to hold the beneficial insect in large numbers in cold storage so as to be available when the pest is present in the stage in which it is attacked.

If beneficial insects can be made to colonize in a new area, there is great economic gain as the biological control of the pest requires no more attention or expense. To judge such success it is necessary for some years to enquire into the multiplication of the beneficial insect and the control it effects. In the case of some pests it is possible that control can be effected economically by periodical releases of artificially produced numbers of a beneficial insect. Where one species fails another may succeed and separate observations have to be made regarding the success not only of different species but even of different strains of the same species. Each experiment has to be carefully planned and closely watched if biological control is to make progress in man's fight against insects.

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

VI. THE MARATHA CULTIVATOR

BY

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The older (and still often used) English spelling is **Mahratta**. In this form the word itself has a fierce kind of look which is in no way belied by history. The Mahratta Ditch at Calcutta, the numerous States resulting from the break-up of the Maratha empire and the hill forts in the Deccan and Konkan, perched like eagles, eyries on inaccessible cliffs, all bear witness to a past which has still a strong influence on the peasantry. One of my greatest friends (now, alas, dead) was a sugarcane cultivator near Poona, humorous, hard-headed and pugnacious. I remember well his showing me some of the cuts in the old Maratha swordsmanship (*shir, chir* and *ashtang*..... *i.e* at the head, the neck and the chest). He had also been a great wrestler in his youth. Even to-day wrestling is by far the most popular of village sports and is as wide spread as boxing in England. Of this man also I recollect that he wanted to make an embankment to block a *nulla* that was eroding his land. For this purpose he wished to use a big boulder of trap rock near-by. The Deccan abounds in these boulders and some of them, like this one, have on them a smear of vermilion, indicating that at some time they have been regarded as the dwelling of some local deity. His labourers were not too keen to remove this, perhaps sanctified, rock, but he pursuaded them to do so and they trundled it off to the *nulla* (*ultun-pultun. ultun-pultun*, *i.e.* rolling it over and over). Suddenly one of the more superstitious labourers got a fright and shrieked that the offended deity was coming after them. The cultivator stopped, blew noisily on his fingers and said cheerily, " Pouf ! She's gone !" After this the boulder was well and truly built into the *bund* with no further alarms.

This tough and cheery type is the typical Maratha, and since I have mentioned their pugnacity and hard-headedness, I might mention something about their **humour**. The humour of a people is often shown in its proverbs. Most nations

Note.—I am deeply indebted to Dr. T. G. Shirname, Assistant Marketing Officer, for much help in preparing this article. I also thank Dr. R. B. Ghatge, Professor of Agricultural Economics, Poona, for useful data. W. B.

Fig. 1. A young Maratha cultivator

Fig. 2. An old Maratha cultivator

have some proverb or other dealing with the impossibility of improving or changing certain things. A Marathi saying of this kind is :—

" *Kadu kāralé*
Sākhret golalé
Tupat tolalé
Tari kadu té kaduz "

This refers to the exceeding bitterness of a well-known little cucumber and may be translated :

" Though you roll it in sugar and fry it in *ghee*, still it's as bitter as bitter can be. " Another Marathi proverb dealing with the same subject says : " Though you put a dog's tail in pipe for years, yet it will still have a kink in it ". Another example : a lady missionary friend of mine was driving a Ford car during the rains in one of the Marathi-speaking districts of the Bombay Presidency. In the words of a well known Scottish Student's Song, " She came to a river and she couldn't get across ", but a dozen or so willing men from the near-by village came and shoved and pushed the car through the muddy water. As they pushed, they sang, and the lady, being much of their own mind and spirit, sang also. They said, " This is fun ", and when they reached the other bank they did not allow her to land but pushed the car back again to the bank they had left and once more over to the further bank, so prolonging the delight of the concert !

The Maratha is a great singer. At sowing time and harvest there is that kindly co-operation among neighbours that is found in many peasant countries. It is called *irjik* in Marathi. The owner of the field which is being sown or reaped by the help of his friends gives them a feed at night and may even provide a goat for the purpose. As the folk work they sing such ' chanties ' as :—

" *Shābās ré wāghā*
Bhālaré dadā "

(meaning " Well done, tiger, well done, brother ").

Again, when in the making of *gul* (*gur*, jaggery) the pan is lifted off the fire to be poured there is sung a four-line religious ' chanty ' that ends in the great shout of " *Satyanārāyan māhārāj ki jai !*" as the big pan is tipped over.

With all these characteristics it is not to be wondered at that, during the Great War, the Maratha battalions, concerning whose military qualities not much was known, should have proved themselves not only valiant, but steady, tenacious, and able to crack a joke in a tight place. As troops, they still sing and a Maratha unit on a route march has no difficulty in providing vocal music when the band stops.

It is not only history that affects human qualities but also geography, and the rather difficult nature of the Maratha country has contributed something to the spiritual and physical make-up of the peasant. The middle part of the Bombay Presidency is called the Maharashtra and comprises the districts of Poona, Ahmednagar, Nasik, Satara, Sholapur, Thana, Kolaba, Ratnagiri and East and West

Khandesh. The so-called Southern Maratha Country comprises the districts of Belgaum, Bijapur, Dharwar and North Kanara. In both areas there are many Indian States of Maratha origin, the most important being Kolhapur. There is a strong Gujarati element in the two Khandesh districts, particularly in West Khandesh. The districts in the Southern Maratha country are largely Kanarese, except a part of Belgaum district. It is in the centre that the most typical Maratha persons and cultivation are found. In this area, laced north and south and east and west by the main line and spurs of the Western Ghats, the Maratha cultivator carries on his agriculture on land of varying quality and in a rainfall that is often precarious. The rain may, however, come in tremendous bursts and this has caused much erosion and shifting of soil. Some of the Deccan hills are so bare of soil that they look as if they belonged to some fantastic lunar landscape. Near the foot of these hills the soil is light and poor, but further away and especially in the bottom of valleys there is rich deep land. In addition there occur pockets of good soil in unlikely places. Generally speaking the soil is not deep. It overlies the Deccan trap, and between the thin top soil and the hard rock is a layer of *murum* (disintegrated trap) which means good drainage as a rule, and in some cases leaching. About eighty per cent of the land is held by cultivators themselves direct from Government. Holdings are not large. In the Konkan (the coastal strip) they are from five to fifteen acres, in the west Maharashtra from fifteen to twenty-five acres, and may be from twenty-five to thirty acres in the east. A holding is not a single compact block but is generally made up of scattered plots, and the distance between these plots may be anything from a few yards to a few miles. This is one of the causes for the cultivator not living on his holding, while another is a certain fear of wandering criminal tribes. Where there are facilities for water and holdings are compact, farmers do live on their holdings, however, and in such cases cultivation is of a high standard.

The conformation of the Ghats has been used by the Irrigation Department to facilitate the construction of certain large reservoirs which are nothing more than deep river valleys blocked at their mouths. These give the water for the Deccan Canals systems and on that water the skilled Saswad Malis made their name and their fortunes in the early days of sugarcane growing when *gul* prices were high. On this water also is now grown the cane of the Deccan sugar factories, and here are got as a matter of course yields of thirty and forty tons cane per acre by ordinary peasants.

Fruit is also grown on this irrigation water and in the Ahmednagar district are some excellent plantations of Santra and Musumbi oranges, while banana plantations are spreading. Irrigation, however, even plus watering from wells, influences only a very small fraction of the area and the dry crops are the most important. Among these *jowar*, *bajri* and rice are the leading ones among the foodcrops, and cotton, groundnut and safflower among the commercial crops. Roughly rice and *bajri* occupy two parallel north-to-south bands on the map, the dividing line being the Western Ghats. *Jowar* is spread over several of the above-Ghat

districts. The two Khandesh districts grow Oomras cotton. and there also is centred the groundnut cultivation. A range of pulses is also grown, mostly mixed with cereal crops.

It is very noticeable that on comparatively poor land which grows *bajri* in the rains the Maratha peasant finds it worth while to use the iron plough, and probably in no area are so many iron ploughs in use as in the Maharashtra. For his bullocks the Maratha cultivator has genuine sympathy and affection. He sings to them while at work on the plough or the well, he has pet names for each of them and after work, when they have drunk, he carefully washes their faces and eyes. He is careful about pairing them for the yoke, and has the greatest exaltation when his animals win a prize in a cattle show. Once a year, at the feast of Pola, the bullocks are worshipped, decorated, taken in procession, and fed sumptuously.

The Maratha cultivator's every-day dress consists of a *dhoti*, a shirt, a turban, a pair of sandals and a rough blanket. This last-named garment is carried about only in cold or rainy weather. To cover himself when sleeping he has a sort of quilt made of old rags by his women-folk at home. This is called a *wakal* or *godhadi*. During warm days in summer he takes over his shoulder his spare *dhoti*, and in the evening, before returning home, he bathes himself and washes his soiled *dhoti* in some stream or well, putting on the clean dry one to go home. On ceremonial occasions he carries, like a plaid, a few yards of bordered or plain linen.

The cultivator generally lives in a village. The village is usually situated on high-lying ground where the soil is poor and light in colour. Hence the village site is called *pandhari* (white) and the outlying cultivated lands *kali* (black). Several villages have still got the old protective mud walls, occasionally loopholed. The accommodation the cultivator provides for himself and his family depends on his prosperity. A house with three rooms and a verandah is not uncommon. The verandah is used for the bullocks and a few milch cattle. Sometimes there is an independent shed for the cattle. More prosperous cultivators may have a *wada*, a two-storey house with a quadrangle of subsidiary rooms behind it. At the busy times of the year the cultivator is afoot for fourteen hours out of the twenty-four but at other times he has little to do, and from many districts men go to the Bombay factories. Before motor transport became so wide spread, they used also to do a lot of carting in the off-season.

The cultivator's food is simple but good. In *jowar* and *bajri* growing districts *bhakris* (unleavened pan-cakes of the whole-meal of these grains) are the staple food. In rice-growing districts, rice forms the principal item of diet. A pungent curry prepared from pulse and onion is taken in all tracts. Wheat, *gur* and milk are used only on ceremonial occasions and festivals. The cultivator is not a vegetarian but does not get the chance to eat mutton more than eight or ten times a year. His meals are taken about 9 A.M., about 1 P.M. and the last one at night along with his family. The cultivator knows what belt-tightening means,

and the time of shortness of provisions in July and August gets the special name of *akhadi*. *Akhadi* therefore has the connotation of scarcity. The Maratha cultivator is very hospitable and provides hot milk and very often tea for the visitor.

The marriage season starts in November when the *kharif* crops have been harvested and there is some money available. The marriage season, however, is at its peak in March and April after all the crops are harvested and this is also the time for village festivals and fairs.

The Maratha is not only tough and humorous but there is also a strong strain of religion in him, for his spiritual ancestry comprises not only warriors like Shivaji but saints like Dnyanadev and Tukaram and these have left him a legacy of hymns and stories which form the subject of night-long séances in the local temple, where, sitting on the floor, he joins in the chants with voice and cymbals. Hence also the pilgrimages which he and his women-folk undertake, mainly to Alandi and Pandharpur, carrying with them the split red pennon that marks the spiritual traveller.

May they not only travel hopefully but also arrive in peace.

VITAMIN-A STUDY OF GHEE. PART VI

ACTION OF SUNLIGHT AND A NEW TEST FOR DETECTING THE DEVELOPMENT OF RANCIDITY

BY

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AND

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THE action of artificial light—particularly ultra-violet rays—on butterfat has been studied by several investigators [Steenbock and Coward, 1927 ; Cannon and Hixson, 1936 ; Supplee and Dow, 1927 ; Willimott and Wokes, 1927 ; Zilva, 1920 ; and others]. Banerjee and Dastur [1936] have shown that destruction of vitamin A in ghee when exposed to sunlight is considerable. Similar observations have been made by Holmes and Pigott [1926] with cod-liver oil. Banerjee and Dastur (*loc. cit.*) have further shown that when the ultra-violet and heat rays of the sun are cut off, the extent of vitamin A destruction in ghee is reduced, although not to a considerable extent. This would suggest that other components of solar radiations also play an important part in vitamin A destruction.

Another observation of interest is that under the action of strong sunlight, filtered free from ultra-violet rays, vitamin A in ghee is gradually lost while the yellow colouring matter is not destroyed until after prolonged exposure. Under the influence of heat (100° C.), however, both the vitamin A and the yellow colouring matter of ghee are destroyed gradually and simultaneously so that a measurement of the change in the yellow tint will in such cases give a reliable indication of the extent of vitamin A destruction.

Heat and light are the two important factors that bring about autocatalytic changes in oils and fats. Heat is only a mild reagent when compared to light for the destruction of vitamin A. The authors [Banerjee and Dastur, 1937] have shown that vitamin A in cow ghee is fairly stable at temperatures up to 125° C. although it is rapidly destroyed at higher temperatures. Further, cow ghee has

been shown to be much more stable than buffalo ghee having an almost identical vitamin A content. It is possible that this difference in behaviour between cow ghee and buffalo ghee is due to the protective action of carotene and other natural colouring matters in which the latter is somewhat poor. Indeed it has been repeatedly observed that carotene rich ghee samepls can withstand heating for over 30 hours at 100° C. for complete destruction of viatmin A and this stability is primarily dependent upon the amount of carotene and other associated natural colouring matters in the particular sample of butterfat.

When the destruction of vitamin A either under the action of light or heat has set in, the blue colour obtained with antimony trichloride is gradually replaced by pink. Some earlier investigators [Wokes and Willimott, 1927 ; and others] have casually mentioned about this red or brown colour, but, the exact significance of this change does not seem to have been demonstrated so far. It was observed that in addition to overheated ghee samples, all old fats whether from vegetable or animal origin, gave a pink colour when tested with antimony trichloride reagent. Samples of refined safflower and cotton seed oil that had developed resinous odour, being stored for a long time, did not give any peroxide test but gave a pink colour with antimony trichloride reagent. It, therefore, appeared probable that this characteristic development of red colour is in some way associated with the type of complex changes which fats undergo and are classed under the term 'rancidity'. The development of pink colour may thus serve as a quantitative method for measuring the degree of rancidity of any sample of fat, provided the increase in pink colour is shown to be proportional to the development of rancidity as indicated by some standard method.

While it is true, that the recognition of rancidity by taste and odour is so easy that there is no need for the use of chemical tests, there are, nevertheless, many cases in which reliable tests may prove of great value in determining the degree of rancidity. A large number of methods have been proposed from time to time for estimating rancidity, *e.g.*, acid value [Martin, 1920], iodine value, [DeGroote, 1931], organic peroxides [Davies, 1928 ; Taffel and Revis, 1931 ; Lea, 1931], colorimetric estimation of aldehydes and other products of oxidation [Kerr, 1918 ; Schibsted, 1932 ; Lea 1934], permanganate titration of water-soluble volatile constituents [Kerr and Sorber, 1923], and the fading of methylene blue colour [Greenbank and Holm, 1930 ; Royce, 1933]. None of the above methods is reliable nor can be applied in all forms of rancid changes, since the chosen component may be the product of a secondary process. However, the rate of development of peroxides has been considered to be one of the best criteria for measuring rancidity [Amer. Oil Chemists' Assoc., 1934] and hence some experiments were conducted in which the red colour was compared with this test and as may be seen from the results (Table I) there is a direct relationship between the red colour and rancidity development.

Experimental

For the experiments butterfat (a typical animal fat) and coconut oil (representing the vegetable group of fats) were employed. The two fats were kept in conical flasks in an electrically heated 'Cenco' oven maintained at 100° C. The flasks were corked and samples removed at regular intervals. Red value was measured by saponifying 5 g. of fat as in the ordinary vitamin A estimation and extracting the unsaponifiable fraction with ether. Excess of ether was distilled off and the unsaponifiable matter dissolved in 5 c.c. of absolute chloroform. To 0·2 c.c. of this solution, 2 c.c. of the antimony trichloride reagent was added, the red colour allowed to develop for two minutes and then matched against standard red glasses in a Lovibond tintometer. The figure so obtained was calculated for that given by 1 g. of the substance as in vitamin A estimation and expressed as red value (R. V.). The peroxide formed was determined by titrating separate samples as recommended by Wheeler [1932] and the results expressed in terms of c.c. of $N/50$ thiosulphate. A typical series of results for the development of red colour and formation of peroxides are illustrated in Table I.

Table I

Relation between thiosulphate value and development of red colour

Observation No.	Ghee		Coconut oil	
	Thiosulphate value	Red value	Thiosulphate value	Red value
1 . . .	0·02	B. V. = 13·2	0·0	0·0
2 . . .	0·09	B. V. = 12·1	0·23	1·5
3 . . .	0·31	B. V. = 5·5	0·65	3·6
4 . . .	0·62	R. V. = 3·3	1·00	4·5
5 . . .	0·92	4·5	1·63	7·7
6 . . .	1·38	7·7	2·20	9·9
7 . . .	2·08	13·2	3·37	16·5
8 . . .	2·76	18·0	..	..

The results show that the increase in red value and the peroxide figure is proportional. Figure 1 shows that for butterfat the line does not meet at the origin, because before the red colour develops it is masked by the vitamin A already present.

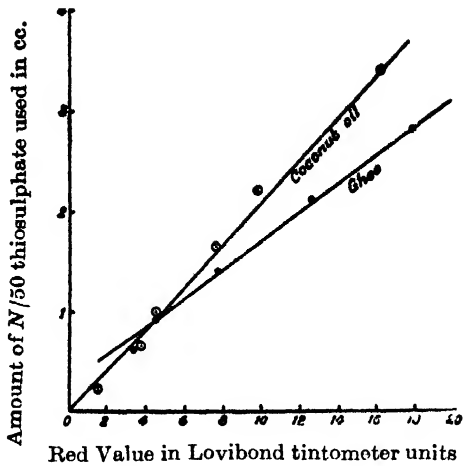

FIG. 1.

It was observed that under similar conditions exposure to light results in the formation of a reddish precipitate in addition to the red colouration on adding the antimony reagent. Thus, in an experiment ghee and coconut oil were kept in glass basins so as to form a layer one inch in thickness and exposed to strong sunlight after covering the dishes with watch-glasses which served to cut off most of the ultra-violet rays. Samples were taken at regular intervals and treated with antimony trichloride reagent. As soon as the reagent was added the red colour gradually began to develop but was also accompanied by the formation of some precipitate thus making it difficult to match the colour. The turbidity thus developed differed markedly from the one usually observed when the antimony trichloride reagent is contaminated with traces of moisture in that the precipitate was flocculent and settled down rapidly. It is therefore inferred that under the influence of sunlight certain substances are formed which give a reddish precipitate with the antimony trichloride reagent. Further studies on the nature of the precipitate are under investigation.

The red colouration is a delicate and sensitive test for detecting rancidity and only 0·2 c.c. of a sample is required for the test.

SUMMARY

(1) The stability of vitamin A in ghee depends to a large extent upon the other natural colouring matters accompanying it.

(2) When fats become rancid they give a characteristic pink colour with saturated antimony trichloride in absolute chloroform. This colour development increases with the progress of rancidity and is found to be proportional to the peroxide value. This test is of particular importance when only a small quantity of the substance is available or other tests fail,

(3) When butterfat and coconut oil are exposed to strong sunlight, their unsaponifiable fractions give a precipitate with the reagent in addition to the red colour.

The authors wish to acknowledge their grateful thanks to Professor V. Subrahmanyan, for his kind interest during the course of this work.

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THE INDIAN VILLAGE—ITS PAST, PRESENT AND FUTURE*

BY

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INTRODUCTION

I TAKE it that no apology is needed in these days for talking about any aspect of 'village and village life'. The city and town which were holding a complete thraldom over the public mind all these years are losing their glamour somewhat in spite of their admittedly alluring attractions; and the 'village' would appear to be getting increasing recognition, particularly in our country and in recent times. I had therefore no hesitation to select this subject for my address.

POSITION OF INDIA WITH REFERENCE TO SPACE AND TIME

With China, Japan and the South-eastern Islands, India is situated in a comparatively densely populated area of the globe—about half the population of the world being crowded into a tenth of the earth's land region. This has had its effects on the type of agriculture practised in this country, the selection of crop for cultivation and the life of the people as a whole.

Secondly, along again with China, India possesses a civilization and culture which was at least contemporaneous with, if not antecedent to, the civilizations of Egypt, Mesopotamia, Greece and Rome. After making considerable progress this civilization has, however, remained in a more or less quiescent and petrified state in our villages for well-nigh two to three thousand years little influenced by the great progress made by the West during the latter part of the same period. It is only within comparatively recent times that the Western civilization has come to spread into and influence the countryside.

ARYAN COLONIZATION OF INDIA AND TYPES OF VILLAGES

The Aryans, who entered the country through the north-west route, first occupied the Indus valley and the Punjab plains and later spread to the east. The new Aryan colonists naturally found plenty of land to settle in and the obvious advantages of group formation brought into being two main types of villages. One was the type similar to what is now termed *ryotwari* where each family or group of persons took up as much land as they could cultivate depending on the number of cattle and able-bodied men in the unit.

*Presidential address to the Indian Science Congress, Hyderabad, 1937.

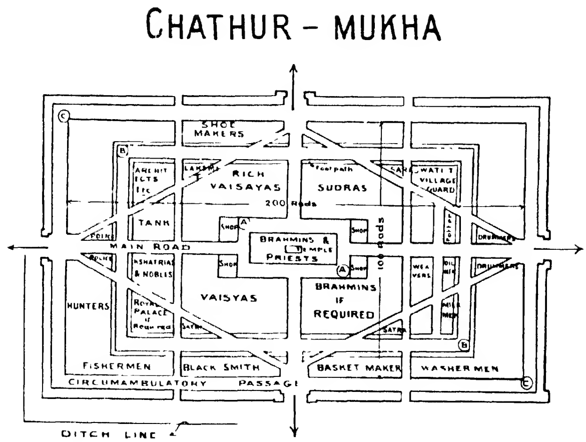

FIG. 1. Ground-plan of a village from 'Manasara' Vol. II by Acharya

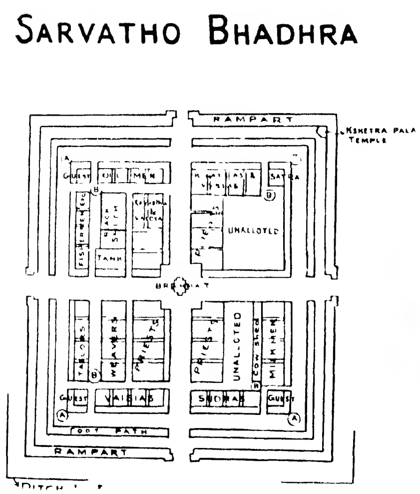

FIG 2. Ground-plan of a village from 'Manasara' Vol. II by Acharya.

FIG. 3. A South Indian village perhaps a thousand years old in which the original layout is still discernible (*By the Courtesy of Rao Sahib T V Rajagopalacharya.*)

The other type called 'joint village' by Baden Powell was founded by powerful families or clans not necessarily agriculturists. The government of such villages was by the well-known *panchayat* system and occasionally a group of such villages belonged to the same clan or owed some kind of allegiance to the same warrior chieftain in return for the protection they enjoyed at his hands. In these villages the cultivating classes were sometimes in the position of tenants. *Ryotwari* villages sometimes got converted into 'joint village' through conquest by some warrior chieftain.

THE INDIAN VILLAGE IN THE PAST

Various books, such as the Arthasasthra of Chanakya (before 300 B.C.), the Sukranithi and the Smrithies of Manu as well as inscriptions unearthed in recent times, give us a fairly clear picture of the organization and government of the village and its institutions in ancient times.

The headman.—The headman was an important officer in village government. His office was hereditary and apparently a vestige of the ancient village chief. He was remunerated by grant of inalienable right to certain lands and later by being allowed to collect and utilize certain taxes from the villagers. He was entitled to collect annually for instance, two shoes from every shoe-maker, two cloths from the weaver, thirteen betel leaves (per day) from the betel leaf vendor and a cash moiety from the shop keeper.

The panchayat.—The headman was assisted and later on effectively controlled by the village *panchayat*. This was a council of elders, not elected, and more or less self-constituted from the elders of the village who naturally and easily commanded the respect of the villagers. Justice was dispensed in the village temple and an oath before the local deity was potent in preventing persons from bearing false witness. The *panchayatdars* also knew the parties almost personally and were thus able to dispense quicker justice.

Taxes for common needs.—The village government was carried on in a brotherly informal way, the opinions of the elders carrying much farther than now. Taxes were levied for communal purposes as distinct from those by the Emperor; and there was a common village fund which entertained the village guests, provided for the indigent and arranged for recreations, shows and performances of acrobatic and jugglery feats. The temple, the village tank, the guest house, as well as other public utility concerns had a claim on this common fund. The central government helped in cases where works of common utility were beyond the capacities of the village.

Village life.—There was not much sanitation in the modern sense of the word and no scavenging. Diseases were naturally few on account of the healthier open life. The science of healing was, however, well advanced for the then conditions and comparatively cheap being based on easily available herbs and both metallic and organic compounds.

The streets were broad. The Arthasasthra prescribes a width of forty cubits for the main streets which were shaped like the 'back of the tortoise' to facilitate drainage. Each caste which pursued its own profession lived in separate parts of the village and it was surrounded by a common and free grazing ground.

Each village had a class of artisans who were hereditary and being non-cultivating were given definite shares of grain at harvest. In return for this the farmer was entitled to the services of the artisans both for his household and agricultural needs.

THE GREAT CHANGE IN THE VILLAGE

Isolated in olden times.—The Indian village of ancient times was practically a self-contained, self-governing unit, having but little contact with the outside world. The villager's outlook and knowledge were limited, rarely extending beyond the confines of his own village and the villager's life ran an even course from day to day. This had been the condition for well-nigh two or three thousand years.

Spirit of competition.—During this same period the West, on the other hand, was rapidly evolving itself from a condition even more primitive than that of the Indian village to that of modern times. The increase of population has intensified attempts to augment the available sources of food by opening up new lands where possible and the struggle for existence has brought to the forefront the idea of the 'survival of the fittest'. The spirit of rivalry and competition has sharpened the intellect in certain directions and the rights of the individual as such are getting increasing recognition.

Commercialization of crops.—One very important result of the co ct with the West has been the development of the export and import trades whi have affected profoundly the kind of crops grown and both the occupation an ode of life of the villager. This has upset the old-time food-centred econ ics of the village and rendering them increasingly money-centred. The more enterprising and intelligent of the villagers are attracted by the commercial life and tend to shift themselves to the nearest town or city temporarily in the beginning but often perman ntly in the end.

THE PRESENT-DAY VILLAGE

Village agriculture.—As agriculture is the sole occupation of the villager its present condition and its effect on the economics and life of the villager are well worth consideration. One outstanding feature connected with Indian agriculture is its great dependence on the monsoons. In spite of the great irrigation works—some of them the largest in the world—and the steady advance in the matter of tapping underground water, it has been estimated that seven-eighths of our agriculture are yet dependant on the monsoons.

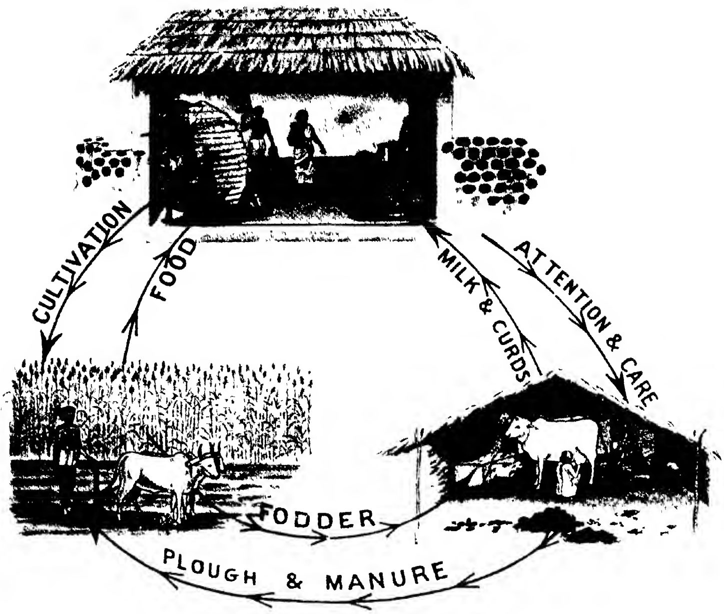

FIG. 1. The villager's household his cattle and his crops form a life-cycle mutually interdependent and helpful to each other

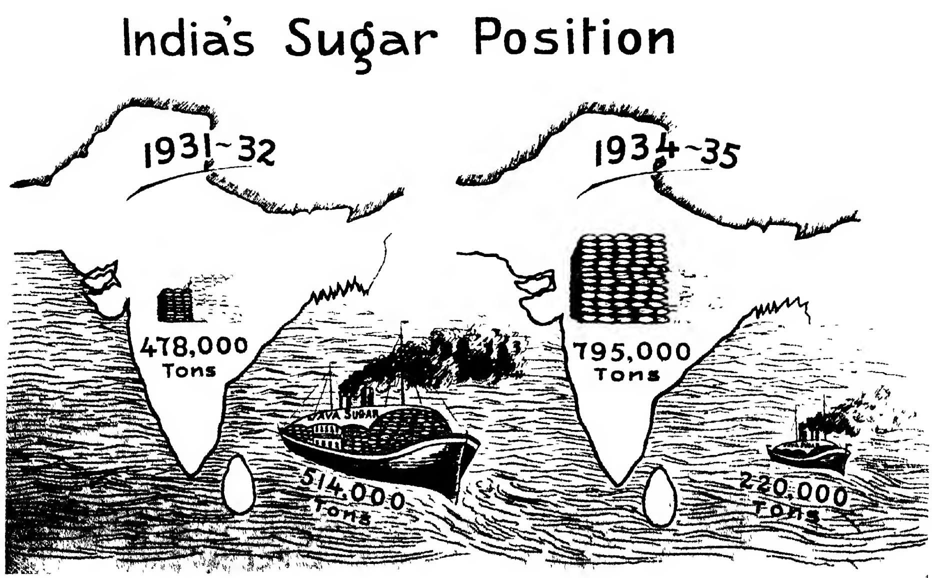

FIG. 2. The recently resuscitated sugar industry of India is employing thousands of additional labourers in the factories besides directly benefiting five million extra agriculturists

Secondly, the villager is so little in touch with world markets wherein the results of his labours are evaluated and sold, that a large portion of his profits is intercepted by the intermediate agencies that market his produce. For this reason the increase in village prosperity has not been as great as the increase in trade.

Thirdly, land available for crop-growing has not increased to the same extent as increase in population. The prevailing sentiments, both social and religious, that directly encourage large numbers of children, were definitely needed in the olden days of plenty of land and low population. These are obvious misfits at the present time when conditions are just the reverse.

Fourthly, the possibility of large increase in production per acre is greatly limited by a variety of causes such as sub-division and fragmentation of holdings and the prevalence of rigid social customs and religious sentiments which cause the waste of such valuable manures as night-soil and cattle-dung and adversely affect the business aspect of agricultural production. Both sub-division and fragmentation are inter-related to each other and result from the same cause, *viz.*, the mode of inheritance of landed properties as obtaining in both the Islamic and Hindu laws.

Sub-division of holdings.—When land was fairly abundant and agriculture practically the only means of livelihood, it would appear but obvious justice on the death of the *pater* to divide the land equally among all the surviving members. At the same time there is a limit in size below which it becomes uneconomical to sub-divide agricultural land.

But perhaps a greater evil than sub-division is what is known as fragmentation. When one wishes to invest in landed properties he does so often by purchasing bits from different individuals and hence located away from one another. When this property is divided after his life-time each sharer gets generally a portion from each of the bits of land and thus the holding of each sharer becomes fragmented.

This state of affairs rules out large-scale operations by outside capitalists who have the resources for up-to-date agricultural methods, generally beyond the reach of the average cultivator. The number of land owners they have to deal with is too large and one recalcitrant can hold up a whole scheme. The value of large-scale operations in raising agricultural efficiency has been amply demonstrated in other tropical countries like Hawaii and Java. The obvious course, therefore, is to take full advantage of the very large supply of human labour and adopt methods of intensive cultivation appropriate to the country.

VILLAGE CATTLE

The Aryan settlers loved their cattle and valued them highly. A grazing waste round each has been the standard feature of the Indian village ; its width was fixed at 400 cubits during Chanakya's times and in the Moghul days it was

as much as the human voice could be heard across. In contrast to China and Japan, milk has been highly valued and extensively used as food from ancient days in our land. This is fortunate for a country like ours which otherwise is largely vegetarian. Milk was not banned even in the case of the semi-recluse who was denied most other articles of diet.

The cattle represents sometimes the heaviest capital outlay of the cultivator next only to land and he loves them almost to a fault. A day in the year is set apart as cattle festival when they are decorated and feasted on sweet rice and cakes. In certain parts of the country like the Vizag and Bellary districts of the Madras Presidency the cattle often occupy the front portions of houses.

But this very attachment and religious regard to the cattle—particularly the cow—is now working to their disadvantage. India is unique in possessing an enormous amount of cattle without making profit from its slaughter. Cattle maintenance is not looked upon as a business proposition and the sentiment towards them is similar to that of a rider to the old horse which has served him well or of the owner of pet animals to the dog or cat in the West.

The villager (and his indebtedness)

Having briefly considered certain important aspects of village life, we are now in a position to consider the present condition of the villager himself. Though till recently but little affected by the changes around him, on account of his isolation both mental and physical, he is being made increasingly aware of the changes around by the extension into the village of such symbols of modern life as the post and telegraph, the bicycle and motor bus.

Economically he finds himself in a very disadvantageous position owing to his steadily diminishing agricultural income in contrast with increasing expenditure due to changes in living even in his own household. Innovations in dress and habits and new wants like tea and coffee are steadily forcing up family expenses.

Dependent as he is solely on agriculture, the need of money always exists. Like agriculturists all the world over, he suffers from the fact that, whereas agricultural income comes in only at particular times like harvest, his expenditure is of a monthly if not of a daily nature. Extra profits from an exceptionally good year are more often wasted in urbanising his surroundings than being put by as reserve against lean years. The heavy indebtedness of the Indian villager is well known and has attracted the attention of all that have cared to study the village.

Village wastes.—While on the subject of the economics of the villager it will be appropriate to consider here the various types of waste that are taking place

in the village. Foremost, perhaps, is the agricultural waste resulting from the uneconomic sub-division and fragmentation of land which precludes its cultivation to maximum benefit. Then come the waste of cattle and human labour due to fragmentation, the drain of village money by way of interest on loans raised by the villagers and loss of valuable manures like human and cattle voids.

Forced idleness.—One important waste which has to my mind far-reaching results is that caused through forced idleness. This is because agriculture, which is often the sole occupation, is not able to keep the village busy all the year round. This forced idleness is very harmful, changes his whole outlook on life and lowers his character in many ways.

Standard of life.—One common complaint laid at the door of the Indian by others and of the villager by the townsmen is what is termed 'low standard of life'. There exists, however, considerable confusion as to what the term really means and though, it is but vaguely understood, it is nevertheless readily resorted to, when there is no room for sound and logical reasoning. To put it briefly and in easy language, a higher standard of life may be defined to consist in getting more out of life's opportunities to the advantage of both the individual and his society. A rise in the standard of living must add to the productive efficiency of the individual or it is no higher though it may be a different standard. All real progress and civilization is interpretable only on this basis. But when a townsman, weak in physique through wrong and unsanitary living, with a diversity of unnecessary and unhealthy wants and unnecessarily and perhaps also harmfully dressed, talks of his higher standard it is an obvious misapplication of the term. It is a case of a more expensive and not higher standard of life. A healthy cultured villager with his fewer and simpler needs but greater depth of character is easily the superior. The merchant, with his desire for commerce, has a tendency to synonymise 'higher standard' with 'increased wants and greater purchasing power'.

The exodus from the village

The most serious of the unfavourable changes coming over our villages is the steadily increasing exodus of people from the village to the town. Apart from the number, the quality of human material contained in the exodus constitutes a serious drain. The capable artizan leaves for the town to make the most of his talents. Culture is now town-centred and there is little scope in the village for the full development or unfolding of one's talents. In the olden days when the village was practically autonomous and had its own funds to cater to the needs and amenities of the villager, the opportunities in the village were greater; and it was possible to retain in the village at least a portion of the intelligentsia, though even then the best of talents resorted to the capitals or courts of kings for patronage.

The future of the Indian village

After this rapid review of the Indian village in the past and the changes that have been coming over it upto the present time we are now in a position to consider its future. In spite of its having become trite, the statement that ours is an agricultural country warrants repetition on account of its far-reaching effects on all our activities. The plough with a pair of oxen is perhaps the one symbol that would properly represent India as a whole with its different classes and communities. The clearly indicated line of advance for the future, therefore, lies in improving rural conditions and rendering our villages better and more efficient in the discharge of duties set to them by the country as a whole.

Both town and village are needed for the full and complete development of our country as a whole. Each has certain specific advantages and inevitable defects. The open air extensions that have grown round towns in recent years—with compound houses and gardens—indicate the attempt to ruralize the town in the matter of health and surroundings, while the post office, the rural dispensary, the school, and even the bus horning its way through the village are in the nature of urbanizing the countryside.

Improving agricultural efficiency

Thanks to the good work inaugurated by Lord Curzon's Government about thirty years ago reinforced and supplemented by the elaborate and far-reaching recommendations of the Royal Commission on Agriculture of 1930, we are now in a position to feel that technical advances in agriculture and allied sciences can be taken to have been provided for.

Advance in this direction, *viz.*, the improvement of crop type and distribution of its seed, has been the most suitable to our present conditions of comparative poverty of resources in other directions. For the production of these types the resources in the way of plant material of more than one country have been and are being systematically employed. Combined with substantial tariff protection afforded by a kind government, it has resuscitated our sugar industry and thus saved a drain to the country of fifteen crores of rupees per annum on the average.

The human element

As the efficiency of any programme of rural improvement, depends primarily on the chief agent in it, the villager, it is important to consider means for increasing his efficiency.

Literacy and education.—If we compare the villager with the townsman one point in which the latter often scores over the villager is his literacy if not always his education. Though it is true that the village teacher did exist in the olden days regular schooling and education were not considered essential. Education given in the village school should obviously possess the rural and agricultural outlook and be vitally linked with the every-day life of the village.

Nature study lessons fit in well with the agricultural life of the villager. Village vacations should be timed to coincide with the busiest agricultural seasons in the village when the boys could perhaps help their parents in the field and gain first-hand knowledge of subjects taught in the school-room.

Intellectual alertness.—A second characteristic of the villager as contrasted with the townsman is often the slower moving intellect of the former. This is not mentioned here in a derogatory spirit; the difference is due to difference in the environment. The every-day struggle with the great forces of nature develops a deeper character in the villager, but in intellectual alertness he is often inferior to the townsman. The linking up of villages with towns and other villages, through better communication facilities, for instance, will remedy the situation.

Business habits.—Yet another common defect of the villager is the lack of the so called 'business' habits and 'business' mentality. This again is due to his environment and tradition. Nature's processes with which the village agriculturist is primarily concerned do not generally need the punctuality of the man of business or commerce. The absence of insurance measures in our villages against crop failures and cattle epidemics, which are by no means uncommon, is largely attributable to the absence of education and business outlook.

The villager's outlook on the world is often narrow because of the isolation and the absence of literacy. Whether he likes it or not, the villager is being dragged into the world currents of commerce and industry and his horizon needs to be broadened by education. His constant fight with forces of Nature over which he has little control, tinges his ideas with almost fatalism. A bad season too often disproves to him the truth in the saying 'as you sow so you reap'. Industrial activities, on the other hand, are associated with processes which demonstrate the control of natural forces by man and this has a tendency to develop in him certain amount of self confidence, if not of human pride.

Cottage industries

In this study of the Indian village, the villager and village life, we have frequently noticed the need and advantages of industrializing the village. The closer cottage industries are linked up with agriculture and agricultural products the better they would fit in with village economics. Cattle being an important adjunct of agriculture, industries like cattle breeding and production of milk and milk products at once suggest themselves. Bee keeping, the poultry industry, fruit growing and canning and preparation of tinned and infant foods for the benefit of the townsman would fit in well into the village.

Other suitable industries would be the partial preparation of manufactured products in the village itself as a rural industry. Cotton ginneries, seed decorticators and oil presses belong to this group. Minor industries connected with products or articles available in the village or vicinity, such as coconut industry

in the West Coast and fish curing in seashore villages, help to keep the villages prosperous.

Other handicrafts and domestic industries, where the needed material is imported from outside and worked in the village during the off-seasons, include weaving, dyeing and the manufactures of toys and trinkets.

Co-operative organisation

Most village activities, on the other hand, have by their very nature to be on the small scale and their being grouped together through co-operative organisations is the only remedy. Through them even the small farmer and producer is enabled to command facilities and advantages generally available only to large-scale units.

There was apparently a great deal of the 'mutual help' and co-operative spirit in the villages of old. The spirit needs to be revived and placed on new lines consonant with the modern age.

Amenities of life

As a class our villages lack the conveniences and amenities of urban life. Conveniences like means for rapid transport, the post and telegraph, the newspaper and the ever increasing improvements associated with the development of electricity are major blessings which it is desirable should be extended to the villages as quickly and as completely as possible.

The general tendency for retired government officials not to return to the village but settle in a nearby town has struck me as unfortunate and is indicative of the general trend.

Conclusion

The town should extend to the village its greater knowledge, quicker living and the manifold amenities of the modern age. Contributions from the countryside are of equal importance. It alone can produce the raw materials of commerce and industry and thus help in the growth of towns and cities. It alone can supply adequate and wholesome food to the millions of our land whether resident in the village or town. Lastly, the countryside alone can imbue the urban 'business' civilization with the deeper character and larger humanities which are nurtured in the villager through his more direct and constant contact with the great forces of nature and of life. Our duty then is clear, *viz.* to improve the village, the nucleus of our country life, and infect its chief agent, the villager, with a chosen culture of the virus of modern age through education and industrialization.

A NOTE ON COMPOSTING ORGANIC MATTER BY THE USE OF CHEMICAL STARTERS

BY

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The North Kanara district of the Bombay Presidency is very poor in cattle population and the available farmyard manure is not sufficient to meet the needs of the locality. The district, however, has large areas of forest, from which organic material can be obtained in abundance in the form of leaves, droppings and loppings. These are collected by the local cultivator and made use of, in the preparation of manure.

The usual method is to collect the dry and fallen leaves along with the loppings of the tender branches and to spread this mixture under the feet of cattle as litter for a day or two. The litter is then removed and replaced by a fresh lot from the forest. Several days' collection of the leafy material, well mixed with the urine and dung of cattle is then stored in pits and allowed to ferment for a period of ten to twelve months. But, as already pointed out, there is a paucity of cattle in this district and it is not always possible for the cultivator to employ this method. Very often the cultivators directly apply to the soil large quantities of fresh leaves without composting them. There was thus a need for a method of composting organic matter in the absence of cattle. Experiments were, therefore, undertaken to prepare organic manure by the use of different types of chemicals as starters. Trials were made not only with the forest material but also with other locally available organic wastes, such as rice husks, betel husks, rice straw, etc. The results of these experiments are embodied in the present paper.

Material

The material available in the ever-green forests in the Kumta Taluka was employed during this investigation. It includes the dry fallen leaves, fresh leaves, and loppings of tender branches, from a large number of species of trees. A random collection of fresh leaves was analysed as to the proportion of the

different species of plants which go to make up the mixture. The results are given in Table I along with their nitrogen and fibre contents.

TABLE I

Name of species	Per cent of total	Nitrogen*	Fibre*
1. *Kasaga* (*Strychnos Nux-vomica* Linn.)	2·2	2·34	16·75
2. *Gurgi* (*Strobilanthes* Sp ?)	6·0	2·13	10·85
3. *Rakta-Home* (*Ficus retusa* Linn.)	0·6	1·42	..
4. *Hirda* (*Terminalia Chebula* Retz.)	8·8	1·46	..
5. *Matty* (*Terminalia tomentosa* W. & A.)	24·5	1·82	16·40
6. *Honagal* (*Terminalia paniculata* Roth.)	8·4	1·70	..
7. *Jamba* (*Xylia dolabriformis* Benth.)	14·4	1·37	..
8. *Taræ* (*Terminalia Bellerica* Roxb.)	6·8	1·98	25·65
9. *Kaval* (*Careya arborea* Roxb.)	16·0	1·35	29·20
10. *Kanagal* (*Dillenia pentagyna* Roxb.)	0·6	1·34	29·90
11. *Halchari* (*Memecylon edule* Roxb.)	11·7	1·52	30·80

*On oven-dry matter.

There are in all eleven species of plants and more than fifty per cent of the collection is made up of leaves of the four plants—*Terminalia tomentosa, Careya arborea, Xylia dolabriformis* and *Memecylon edule*. The nitrogen content varies from 1·5 to 2·3 per cent, while the fibre content is between sixteen and thirty per cent. It is, therefore, evident that the rate and amount of decomposition and the nature of the final product depends largely on the proportions of these different species of leaves present in the heap. It also depends on the percentage of fresh green leaves, for, being more succulent and less lignified they are more easily decomposed, as shown below :—

	Nitrogen	Fibre
Manure from green leaves	1·76	9·50
Manure from dry leaves	1·25	16·33

Method

Preliminary trials were made with a large number of chemical starters. The list of these and the amounts used are given in Table II. The mixed material obtained from the forest was spread out in a thin layer of three to four inches deep. A solution or suspension of the chemical starters was sprinkled profusely and a second layer of forest material was spread on top and the solution again sprinkled. This process was continued till a height of four to five feet was attained. This heap was placed under shade on an elevated piece of ground, so as to minimise excessive loss of moisture. At intervals of eight to ten days, the heap was raked over to ensure sufficient aeration and watered sufficiently to keep up sixty to seventy per cent moisture. Fermentation was found to be complete in about 90 to 100 days and the final produce in each case was well mixed and analysed for nitrogen and fibre. The results are given in Table II.

Table II

Chemical starter	Quantity (on dry matter) per cent	Nitrogen per cent	Fibre per cent
Adco Accelerator	7·5	1·21	9·08
Adco Mixture	7·5	1·81	12·26
Bone-meal	4·0	1·47	13·76
Calcium cyanamide	1·5	1·36	11·1
Ammophos	1·5	1·67	16·42
Ammonium sulphate plus Calcium carbonate	1·5 / 5	1·76	15·83
Calcium carbonate	5	0·96	..

Judging from the friability, crispness, smell and ripeness, the manure obtained by the use of ammonium sulphate and calcium carbonate together was found to be far superior to the others, while Adco Mixture was the next best. In all further experiments, therefore, ammonium sulphate in combination with calcium carbonate was employed.

Minimum dose of ammonium sulphate

With a view to determine the minimum amount of ammonium sulphate required to bring about the maximum degree of fermentation in the heaps, trials were made with varying quantities of ammonium sulphate in combination with five per cent calcium carbonate. Trials were also made with cattle urine and dung as starters. The methods of applying the starters, watering, etc., were the same as before. At the end of ninety days, the degree of fermentation brought about in each case was judged by the amount of disintegrated leafy

material passing through a sieve of 1 c.m. mesh. These results along with the chemical analyses in each case are given in Table III.

TABLE III

Starter	Amount of nitrogen in starter per 100 parts of dry organic matter	Maximum temperature attained	Moisture	Total nitrogen	Ammoniacal nitrogen	Fibre	Amount passing through 1 c.m. sieve
	per cent	°C.	per cent	per cent	per cent	per cent	per cent
Calcium carbonate (five per cent) Amononium sulphate	0·1	46	7·74	1·12	0·052	20·85	72·5
Ditto	0·3	48	8·94	1·22	0·051	16·37	86·2
Ditto	0·6	50	8·62	1·45	0·051	17·10	85·2
Ditto	0·9	49	8·32	1·56	0·58	17·40	86·3
Ditto	1·2	49	7·66	1·76	0·078	15·83	86·7
Cattle dung solution	0·1	...	...	...	...	...	40·0
Ditto	0·3	...	...	...	...	...	59·4
Cattle urine solution	0·1	...	...	...	...	...	79·4
Ditto	0·3	...	...	...	...	...	81·5
Cattle urine	0·1	...	...	...	...	...	69·4
,, dung	0·3	...	...	...	...	...	80·4
Manure of eleven months' standing Prepared by cultivators' method	...	36	5·22	0·737	0·017	26·32	70·6

The results indicate that there is not much difference between the heaps treated with 0·3 per cent nitrogen as ammonium sulphate and those treated with higher doses of nitrogen. It was observed that the higher doses of nitrogen merely accelerated the process in the earlier stages. But later on the differences were not marked. A mixture of calcium carbonate and ammonium sulphate at the rate of five per cent and 0·3 per cent nitrogen, respectively, seems to yield the best results. Cattle urine and dung can also act as efficient starters and can yield good manure, provided the other details of raking and watering as described above are strictly followed. But these materials are not available in plenty in this locality.

In all the above trials, the manure was allowed to ferment in heaps above ground. The local farmer's method is to store them in pits. Both these methods of storage were, therefore, compared. The analyses of the manures after ninety days show that heaping above ground is more beneficial. There is better aeration

and hence more decomposition, resulting in a final product with lesser fibre as shown below :—

Method of storage	Fibre	Nitrogen	Remarks
Heaping above ground .	7·92	1·64	Crisp and friable, smell of ripe manure.
Storing in pits . . .	14·06	1·57	Interior portions packed; insufficient decomposition.

TRIAL OF THE COMPOSTED MANURE ON THE RICE CROP

The newly prepared manure was next tried on a rice crop as to its effect on the yield of grain and straw. The experiments were conducted on 1/20th acre plots and lasted for three seasons—from 1927 to 1931. As a check, manure of eleven months' standing prepared by the local cultivator's method, was employed. The results as given below, show that the composted manure gives in every case a higher yield of both grain and straw. On an average, the increase over the local manure is thirteen per cent for grain and twenty per cent for straw.

TABLE IV

Year and set	Local manure from forest leaves	Composted manure from forest leaves	Increase per cent
1927-28 Set I Grain . . .	916	1036	13
Straw . . .	980	1235	26
Set II Grain . . .	1095	1295	19
Straw . . .	933	1430	53·2
1928-29 Set I Grain . . .	1928	2014	4·4
Straw . . .	2036	2236	9·8
Set II Grain . . .	2940	3140	6·8
Straw . . .	2858	3230	13·0
1930-31 Set I Grain . . .	1789	2144	19·8
Straw . . .	1915	1988	3·2
Set II Grain . . .	2017	2582	28·0
Straw . . .	1822	2651	45·4
Set III Grain . . .	2066	1775	—14
Straw . . .	1661	1609	—3
Set IV Grain . . .	1993	2188	19·8
Straw . . .	2388	2414	10·3
Average Grain . . .	1843	2049	13·8
Straw . . .	1799	2197	22·2

Yield and cost

To treat one ton of the leafy material of the forest with 0·3 per cent nitrogen and five per cent calcium carbonate thirty-four lbs. of ammonium sulphate and 112 lbs. of calcium carbonate are required in addition to about 500 gallons of water. An equal quantity of water has to be added at the time of the second watering, after about ten days. At subsequent rakings of the heap at intervals of eight to ten days, 150 to 180 gallons of water are sufficient to maintain the moisture content at about seventy per cent. Within a week, the temperature rises to about 50°C. and gradually comes down after thirty to forty days. After three months the fermentation will be complete and the final material resembles the cultivator's farmyard manure of ten to eleven months' standing, in colour, feel, friability and smell.

The yield from one ton of forest material is about seven to eight cwts. of well fermented organic manure which can be immediately applied to the soil.

The cost of production of one cart-load of manure by the above method works out at Rs. 2-14-0 calculated as follows :—

	Rs.	A.	P.
Labour for collecting material from forest	1	4	0
Cost of chemicals	0	15	0
Labour for stirring, watering, etc.	0	11	0
Per cart-load . .	2	14	0

Farmyard manure produced locally is sold at the rate of Rs. 2 to Rs. 2-8-0 per cart-load. To this must be added the cost of carting from the manure pits. When this is done, the cost of the manure, prepared by the new method, works out to be nearly the same as the local farmyard manure. But very little of the latter is available for sale.

Use of organic waste other than forest material

Among the other organic waste materials available locally may be mentioned *jungle* grass, rice straw, paddy husks and betel-nut husks. All these—particularly the last two—are highly fibrous and very difficult to decompose. Attempts were made to compost them using the same methods as in the case of the forest material. As before, ammonium sulphate in combination with calcium carbonate was found to be the best starter. But in these cases, higher doses of ammonium sulphate and longer periods of fermentation (eight to twelve months) were found to be necessary. This may not work out to be economical. However, the trials showed that the method could be successfully employed to produce well-decomposed organic manure even from such highly fibrous material as paddy husk and betel-nut husk.

Summary and conclusions

From the above, it can be concluded that in the absence of cattle, organic wastes can be composted by the use of chemical starters. Ammonium sulphate with calcium carbonate acts very effectively. In the case of the leafy material of the forest material round about Kumta, the economic dose of these starters is 0·3 per cent nitrogen as ammonium sulphate and 5 per cent calcium carbonate. The organic material must be well mixed with a suspension of these two starters and heaped above ground under shade. The heap must be raked and watered at intervals of eight to ten days. Aeration must be good and moisture content should be maintained at sixty to seventy per cent. Provided these precautions are carefully carried out, the fermentation will be complete in about ninety days and the manure will be ready for application to the soil. The cost of manure by this method is not very much greater than that by the cultivator's method.

Though it is not cheaper, the new method has the following advantages over the cultivator's method : (1) It can be employed in the absence of cattle. (2) It is very much quicker, requiring only three months as against the ten months required for the cultivator's method. (3) It yields a final product very much superior to that given by employing the cultivator's method. When applied to rice fields, it has consistently given higher yields of grain and straw. (4) The presence of added lime is good for the acidic laterite soils of North Kanara, which are normally deficient in lime.

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VETERINARY SCIENCE IN INDIA, ANCIENT AND MODERN, WITH SPECIAL REFERENCE TO TUBERCULOSIS

BY

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INTRODUCTION

SINCE the advent of life there has been disease and death in this world. As in all other branches of study, the ancient Aryans cultivated in the science of medicine a high degree of excellence. Veterinary science, specially relating to horses, elephants and cattle had also developed to a high degree, as these animals played a very prominent part in the life of ancient India. These animals formed the mainstay of the Indian army, and also the chief paraphernalia of Indian Princes. It is no wonder then, that an intimate knowledge of these animals was a necessity, and that guide books and manuals should have been written on the methods of their keep and care, both in health and in disease.

ORIGIN OF ARYAN CIVILISATION

It is not the purpose of this paper to go into the question of the origin of Aryan civilisation. There are historians who trace the birth of the Aryan race to the mountainous parts of Central Asia, while there are others who say that the Aryans had their origin in Scandinavia or Northern Germany. While Messrs. Grassman and Benfey have been able to fix up the origin of the Vedas and other Hindu literature to somewhere about 2000 B. C., Professor Jacob of Bonn supposes the date to go back to 4000 B. C. There are yet others who date them to the even more remote glacial periods. However, it is enough for our purpose to assume, that the Vedas took their origin at some remote past, of which today we have not the least conception. Philologists and historians have been able to fix up the date of the origin of the Vedas to some remote antiquity, and have been trying to find out a foundation from which they can build up their future history. The self-born Brahma with the object of guiding the world created the four Vedas and taught them to other Gods.

BIRTH OF INDIAN MEDICINE

The two Asvins or the sons of the Sun God became the particular custodians of Atharva Veda, which is one of the four Vedas. This contains the treatises on medicine. They thus became the medical attendants in the heirarchy of heaven.

Fragments of medical knowledge can be gathered from the surviving hymns of Atharva Veda, and among many other things we find therein treatment for worms in cattle. Then came the Upa Vedas or supplementary Vedic hymns, and the same self-created Brahma produced the Ayur Veda, or the science of life, with a view to give detailed instructions to mankind on the treatment of diseases. The hymns of Ayur Veda have perished. A few fragments however remain, and commentaries thereon are found in some later Indian literature. From this second-hand literature available to us eminent philologists are of opinion that for ages past it was the Ayur Veda which was regarded as the very foundation of Hindu medical science. Subsequent history traces the birth of Dhanvantri, the Vedic father of medicine, and through him—Susrutha, the founder of Hindu surgery, and Charaka, the founder of Hindu medicine, to whose authorships the two standard works on surgery and medicine, *viz.* the Susrutha Samhita and the Charaka Samhita are respectively ascribed. There are evidences to show that these authors and their works were known and appreciated by other nations. The Arabs have quoted them in their works and were in turn quoted by the Romans. Professor Deitz has discussed all these in detail in his article on the "Proofs of antiquity of Hindu medicine". So much for the origin and development of Hindu medicine in general.

Origin and development of Hindu veterinary medicine

Contemporaneous with the origin and development of Hindu medicine, veterinary science was also developed to a high degree of perfection. As already pointed out, in the Atharva Veda we find particulars of the treatment for worms in cattle. In the Charaka Samhita we find the disciples asking the Guru Atreya as to how clisters were to be made and administered in cases of animals such as elephants, camels, cows, horses, sheep and goats and the latter, describing to them the details. In Parasara Samhita the care of cows in disease and in pregnancy has been well described. In Agni Purana we find detailed references on the care and management of elephants. One fact is clear, that literary works in Sanskrit abound in allusions to the veterinary science as also in the vocabulary used in the ancient original works. As in the case of Ayur Veda, the authorship of many of these standard veterinary works has been ascribed to *rishis* or other saintly beings. Many and varied are the works that appear to have been written on veterinary science. :—

1. *Asva Vaidyaka* or equine medicine has been ascribed to one Jayadatta Suri.
2. *Asva Chikitsa* or treatment of horses to one Nakula.
3. *Asva Lakshana Sastra* or science on the characteristics of horses—not printed, only manuscript copy available at the Government Oriental Manuscript Library, Madras. Treatise on the different breeds of horses and their characteristics with hints for finding out the good

specimens among them, duration of their lives, rules for their feeding, etc.—Authorship attributed to one Salihotra.

4. *Asvayurveda* or knowledge of the life of horses—not printed—only manuscript copies available at the Government Oriental Manuscript Library, Madras—an exhaustive work on the characteristics of horses and the treatment of their diseases in 820 pages.
5. Bovine Medicine attributed to one Sahadeva.
6. *Go Chikitsa* or treatment of cows—not printed, an old palm-leaf manuscript available at the Government Oriental Manuscript Library, Madras.
7. Elephantology.—Several works on *gaja sastra* or elephantology appear to have been written by several authors, the chief among them being Gautama, Narada, Mriga Charma, Rajaputara, and Vyasa. But these books appear to have been lost. *Hastyayurveda* (knowledge of the life of elephants), which is ascribed to sage Palakapya, is the most ancient among them and the one now available to us. From the account given to us in the extant works, about the origin and development of *gaja sastra* or elephantology, this must have been the most ancient standard work. Apart from the printed edition of this work, there are a few other manuscript copies available in Adyar, Madras and Tanjore. But none of these tally, each of them having a different reading.
8. *Mriga Pakshi Sastra*.—In addition to the above we find in the Adyar Library a manuscript called the *Mriga Pakshi Sastra* or the science of animals and birds by a Jain author called Hamsadeva.
9. In the Tanjore Palace Library, we find two great illustrated manuscripts—one on elephants attributed to the authorship of Palakapya and the other on horses attributed to Salihotra dealing with the several breeds of elephants and horses in ancient India with coloured diagrams showing how the breed, nature, temperament and quality of each animal can be unmistakably studied by its general conformation.
10. *Mathangalila*.—Recently Professor Edgerton, Professor of Sanskrit and Comparative Philology, Yale University (U. S. A.) has translated into English a small manusctipt booklet called *Mathangalila* or the elephant sports of the Hindus, but the credit of translating this manuscript for the first time in a foreign language goes not to the American Professor above-mentioned, but to a German scholar, Dr. Zimmer, who had already translated this work into German, long before the former had known of its existence. This manuscript appears to have been based entirely on the treatise of Palakapya.

These are the few original standard works on veterinary science now available to us from ancient India. All these works form very interesting study, and throw a flood of light on the supreme advancement of veterinary science in prehistoric times. As time went on and when history came to be written we find that veterinary science also made considerable progress. Under Buddhism veterinary science reached a high degree of development. Horses, elephants, cows, fish, game birds, etc., received veterinary aid. The game-keeper, the superintendent of forest, and the superintendent of horses and elephants, each became a high officer of the Buddhist state. Under the reign of Chandragupta in 316 B. C., our modern system of bird and animal sanctuaries had been fore-stalled, and whole tracts were devoted to their preservation and care. Regulations were laid down dealing with the minutest details of the proper ration to be given to different animals at different ages, both in sickness and in health ; and over their ailments was lavished a care which may well serve as an example to the modern veterinarians. When Buddhism held sway, hundreds of veterinary hospitals, managed and staffed by the state veterinary doctors were set up all over India. The reports of the two celebrated visitors, Megasthenes and Arrian bear ample evidence to the above. In the words of Captain C. Johnstone of the Wellcome Historical Museum, India was veritably an 'apotheosis' of the animal world. We can still find traces of these animal hospitals in various parts of India, particularly amongst the Jains. Edicts of the Emperor Asoka, engraved on the great rocks at Jarrada in Ganjam district and in the Molakkamuru in the Mysore Province, show evidences of the existence of well-equipped veterinary hospitals. These are now under the care and management of the Indian Archæological Department. This then was the state of veterinary science in India at one of its most glorious epochs.

I am not at present able to assess the real worth of veterinary science as it existed in ancient and medieval India. From a cursory view of some of the works mentioned above, it is apparent, that this science in those days must have been fairly well-advanced. A broad classification of the several diseases, and a clear and analytical description and treatment of these, are invariably the main features of every one of these ancient works.

Tuberculosis

For illustrating the above, I am at present taking up the disease called tuberculosis, which is one of the major diseases, commanding world-wide attention, and wide-spread investigation and research. In the *Indian Veterinary Journal*, Vol. I, No. 4, page 282 we find the following remarks :—

> " The discovery of tuberculosis in our elephants is one of great historical importance in the veterinary science, and is due to the labours of the distinguished research worker, Professor J. T. Edwards."

Again in Lieut.-Col. G. H. Evan's book "On Elephants and their Diseases" we find the following :—

"Tubercular disease, as far as I am aware, is extremely rare in elephants, probably owing to their mode of life; however, that it may occur is proved by an interesting case which was reported by Dammann and Stedefer of one of the two elephants which were sent to the surgical clinic of the Hanover Veterinary School in July 1908. * * * * * * * The result of bacterial examination seemed to show that the disease was one of human origin. * * * In any case the disease is not likely to be diagnosed in the *jungle*."

Notwithstanding that the first discovery of tuberculosis among elephants was made by Professor J. T. Edwards, and the remarks of Lt.-Col. G. H. Evans, about the rarity of tuberculosis among elephants, there are overwhelming evidences in ancient Indian literature to show that this disease was common among the elephants, and that ancient Hindus have been able to diagnose and treat such cases in those days. In the book of *Hastyayurveda* or elephantology which dates back to the period of the Ramayana Epic, and of which a reference has already been made, this disease has been dealt with in great detail in two different places, *viz.* once under the heading of fevers in Chapter IX of Part I, and again under the heading of wasting diseases in Chapter LX of Part II. I am giving below an actual translation of only the relevant portions, of what appears under the heading of fevers :—

"Whenever an elephant while it is already exhausted on account of overwork either in the hot sun, or walking long distances, is allowed to take in dirty water, or unwholesome food, and allowed to sleep in bad, insanitary stables, or not allowed to sleep at all, the bodily humours become vitiated and the animal first shows signs of flatulence and debility. By continued neglect on the above lines, the animal begins to show marked signs of emaciation, heavy and laboured breathing, and frequent vomitting of the ingesta. There is loathing of food, even for green meadow grass and tender branches of trees. As the disease progresses, it becomes drowsy, meditative, and easily irritable; throws down the limbs as if much exhausted, and with a distressed mind it again pulls up its forepart of the body. Emaciation gradually increases to a great extent, and the animal assumes an yellow colour like that of turmeric. With great difficulty it takes in one or two boluses of food, and when it takes in the third one, the whole thing is vomitted mixed with either phlegm or blood. Because there is slow and gradual emaciation in this disease, it is called *mridugraha pakala* or slow wasting fever. Experts call this disease by the name of *raja yakshma* or pulmonary tuberculosis."

Treatment.—There are several prescriptions given in the book of which I am giving only one or two. *Agalia Roxburghiana* and *Zehneria umbellata* should be well powdered, boiled in water and the decoction thereof should be given in sufficient quantities mixed with honey. To relieve vomitting *Hyperanthera morunga*, *Rhus odina* and *Aegle marmelos* should be powdered and given in honey. A compound powder of the bark of *Pterospermum acerifolium*, seeds of *Boswellia serrata*, lotus stalk, *Flacortia cataphracata*, *Agalia roxburghiana*, *Ipomea digitata*, *Chebulic myrabolams* and *Andropogon muricatum* may be given in honey. Having relieved the animal of its vomitting by some of the means mentioned above, suitable anointments, linaments, and medicated vapour baths should be resorted to. Detailed prescriptions of these have been left out for the present. Regarding food, it is said that it must be palatable and nourishing, capable of maintain ing the patient's strength. Barley, dried fruits of *Zizyphus jujuba*, black gram mixed with ghee or clarified butter, bamboo leaves cooked with rice and seasamum in milk, the flesh of hog, deer, hare, sheep and goats, etc. cooked, suitably flavoured and salted have been recommended, according to the patient's indication.

Under the heading of general remarks in this disease it is said, " This disease called pulmonary tuberculosis is a dreadful affection, difficult of treatment, and dangerous to the life of the patient. To begin with, the attack may be slow, but it gradually develops and becomes dreadful, finally ending with the life of the animal. Once attacked, the animal may live for four, five or eight months or even for a year, but it is not freed from the disease. With great care and caution, successful treatment of the disease is possible, and the physician who successfully treats this disease, should always be held in high esteem ".

I am giving below a short review from what appears under the heading of wasting diseases, as the Chapter itself is a long one containing twelve printed pages in Sanskrit verse.

This disease is classified into different types as follows :—Disease affecting (1) bodily fluids, (2) blood, (3) flesh, (4) bone marrow, (5) bone, (6) adipose tissue and (7) seminal fluid. Then follows a description of the symptoms and the differential diagnosis of each of the several varieties. It is said that it is an indispensable preliminary to a successful treatment to provide a good and comfortable stable, according to the climatic condition, giving full freedom in all its movements, supply of good food and sufficient bedding, use of kind words, and in short everything conducive to the animal's bodily comforts and mental enthusiasm. The treatment itself is a long and varied one. Lack of space forbids me to give full details of the treatment.

General remarks

It is thus proper to conclude from what has been stated above regarding tuberculosis, that veterinary science in pre-historic India, must have been in a very advanced state. It has to be pointed out that many such valuable literature is

lying latent requiring a united effort on our part, to bestow on them a careful study failing which they may all be completely lost. Many American professors and German scientists have taken great interest in the ancient Indian scientific literature, and have bestowed much of their valuable time and labour to a study of these. An extensive investigation of the ancient Indian veterinary science is as important and indispensable as the other branches of veterinary research now being carried on all over India.

Conclusion

We are aware of what is being done in the cause of human medicine. By the untiring efforts of eminent Western scholars like Aninsley, Wise, Roxburgh, Hooper, Dymock, Captain C. Johnstone and others we see signs of the growing popularity of Indian medicine, and the Government of India recognizing the value of the Indian medicine have recently opened an All-India Bio-chemical Laboratory in Calcutta, to standardise Indian drugs. In this connexion mention may be made of the latest report of the Scientific Advisory Board of the Indian Research Fund Association, Simla, and the note of the Director of Public Information thereon, published in May last, the most interesting feature of which relates to indigenous drugs. The investigation of some of these drugs has led to very interesting results. It is recorded in the reports that a " Study of *lauha bhasma* (calcined iron) shows that ancient Hindus appear to have possessed a more advanced knowledge of iron, and appreciated that iron preparations should be administered in an assimilable form ". So far as the critical study of the value of the indigenous drugs is concerned, both the medical and the veterinary professions are almost on the same footing. And in the light of what is stated above I feel confident that it will be admitted by the veterinary profession in India, that every effort should be made to un-earth all the literature on ancient Indian veterinary science and find out what these contain. Such a study may afford ample scope and basis for further veterinary research.

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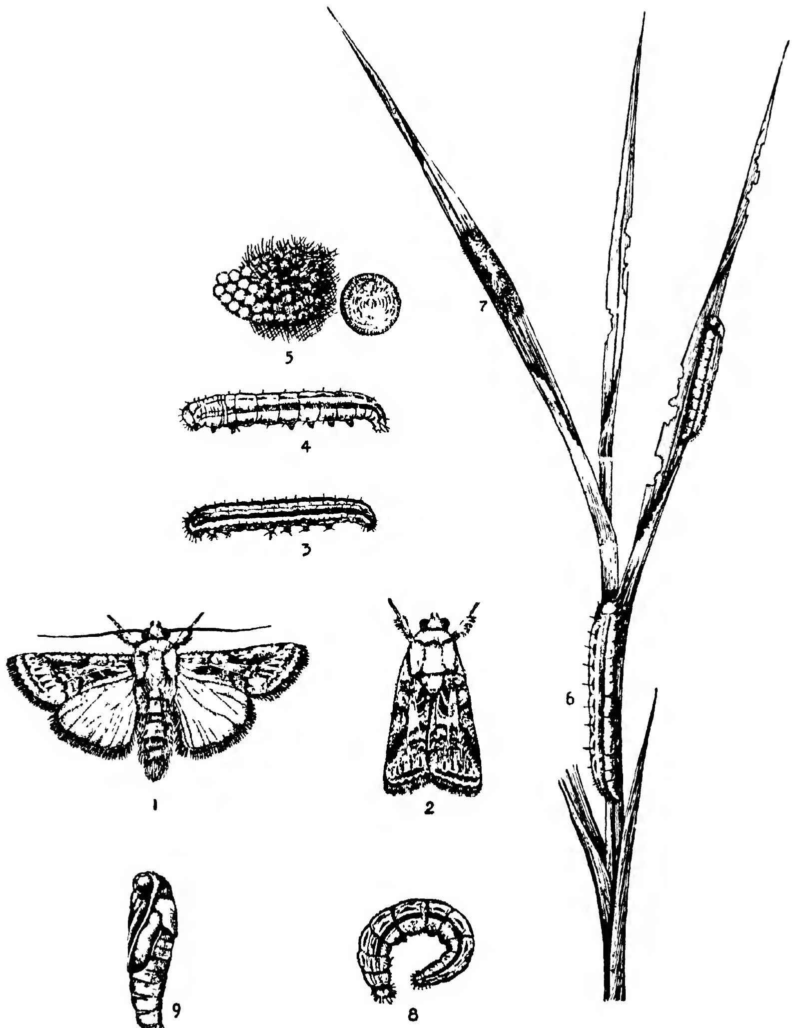

ARMY WORM OF PADDY

FIG. 1 Moth wings spread.
" 2 " " closed.
FIGS. 3, 4 Caterpillars.
FIG. 5 Egg-mass and one egg magnified.
" 6 Paddy plant with caterpillars damaging the leaves.
" 7 Egg-mass on plant.
" 8 Curled up caterpillar in ground.
" 9 Pupa.

BIONOMICS OF THE SWARMING CATERPILLAR OF PADDY IN SOUTH INDIA*

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Introduction

It is well known that among the insects injurious to paddy in South India, the Swarming Caterpillar (*Spodoptera mauritia* Boisd.) is practically the most destructive, causing very serious damage to the young crop almost every year in one or other of the various rice areas of the province. As a result of investigations during the past many years a considerable amount of data have been collected on the bionomics of this notorious insect, and during the past two or three years some special attention was devoted in this direction. It is the purpose of this paper to present a brief resumé of the work done previously and add a summary of the recent studies made on this insect by the writers, particularly the general features and habits of the caterpillar, which is really the destructive stage of the pest.

Previous work on the pest

Being one of the most important of paddy pests, the insect has been receiving some attention for the past many years. The first review of this insect as a pest is a passing reference by Lefroy in his book [1906] while speaking of the caterpillars feeding openly on rice. We next find references to it in Fletcher's book [1914] giving a brief but useful note on the insect and its different features. Of the later references two papers, which are devoted exclusively to the consideration of this insect, are those by Ballard [1921] and Rao [1926]. The former mainly deals with the elaborate plan of a campaign which was arranged in Malabar against this insect in 1920. It also gives the names and figures of the Tachinid flies and birds that are known as the natural enemies of the pest. Rao's paper while mainly dealing with the difficulties generally experienced in controlling this pest also gives us some helpful information regarding the egg-laying

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capacity of the moth, habits of the Techinid Fly (*Cyphocera varia*) and some remarks on the usual measures of control. The latest references to this insect are to be found in the two papers on paddy insects by one of the authors [Ramakrishna Ayyar, 1932, 1933] and in the recent administration reports of the Madras Government Entomologist on the investigations carried on from time to time on this pest. In the two papers of 1932 and 1933, there are very brief accounts of the insect and its different aspects. A reference to this insect in connection with seasonal influence on pests is also made in a recent paper by the authors [Ramakrishna Ayyar and Anantanarayanan, 1935].

Geographical distribution

The pest is one of the most widely distributed among insects, being found practically in all the tropical countries throughout the world. Outside India in the East, it is recorded from Ceylon, Java, Malayasia, Philippines and Hawaii. In South India, occurrence of this insect from time to time is known from almost all rice areas but specially from Cochin, Malabar, Travancore and the Northern Circars. The insect has been known to appear in pest form regularly every year and do considerable damage specially in the *kole* areas of South Malabar and Cochin ever since the *kole* cultivation has been in vogue. The pest is known by different vernacular names such as *Karakottan*, *Olapuzhu*, *Laddipurugu*, etc., in the different localities.

Systematic position and general features of the adult moth

The Swarming Caterpillar of paddy, *Spodoptera mauritia* Boisd., is the larva of a Noctuid moth. The moth has been described by Hampson in the Fauna of British India [1894]. The moth (Plate XLV, fig. 1) is stout built and has a general grey brown colour. There are one or two other moths with which this insect is likely to be confused, *e.g. Prodenia litura* Fb., *Spodoptera*, according to Hampson, differs from *Prodenia* " in having immensely developed tufts of hair on the forewings, more conspicuous ". Three species of *Spodoptera* are known, *viz. S. mauritia* Boisd., *S. abyssinia* Gn. and *S. pecten* Gn. The two former have been recorded from South India and of these, *S. mauritia* Boisd. is the one of economic importance. From an examination of the numerous specimens of the moth it has been found possible to distinguish the male insect from the female. In the case of the former, the forelegs are comparatively stouter with tufts of hair conspicuous and the slender abdomen ends in a pointed tuft of dense long conspicuous scales. There is also a clear white oval spot about the middle of the forewing, with an adjacent black patch less marked. In the female, the forelegs carry slender and fewer hairs, the abdomen is stout with the last segment bearing a thicker and shorter tuft made up of fine short hairs. The black patch on the forewing is conspicuous by the absence of the characteristic white spot of the male. Ordinarily, the male form is slightly smaller than the female, but is the more active of the two. The moths are very active after dusk and possess strong

powers of flight. They hide during day in crevices in the soil, under clods or under thatches in sheds and are difficult to detect, their colour very well simulating the surroundings. They are not attracted to light, but on the other hand a powerful light appears to disturb them from their hiding places immediately after dusk, and thus, their presence in a suspected area is often easily located. The insect is exceedingly prolific in nature as are many of the Noctuid ' cutworms '.

Egg-laying.—The eggs (Plate XLV, figs. 5 and 7) are laid on the tender parts of the paddy leaf or stem. Occasionally the egg-masses are found covering the white sprouts of the germinating paddy in contact with the soil. One moth is able to lay five to six masses, number of eggs in each varying from 50-500. The maximum number recorded in the laboratory rearing has been 2,750. Emergence of moths takes place mostly late in the afternoon and during nights. In the course of rearing under laboratory conditions the pre-oviposition period was three to six days though moths are found to copulate the next day after emergence. The ovary of a freshly-emerged moth when dissected contained 1,376 eggs besides large number of immature ones arranged in threads lying coiled up in the abdomen. Hairs to cover the eggs are found at the tip of the abdomen. It would appear that in nature the gravid moths after copulation move to great distances before the eggs are laid. This feature evidently helps in the wider distribution of the pest. In nature, the moth is able to select a crop of suitable stage for egg-laying. The egg-masses are covered by a layer of brownish short hair from the abdomen of the female. The largest egg-mass once collected from the field measured 1¼-in. in length and ¼-in. in breadth and contained as many as 727 eggs.

Life-cycle and habits of the caterpillar

(*a*) *Life-cycle.*—In the laboratory the eggs hatch in four to five days, the larval period lasts from twenty-one to thirty-two days and the pupal period five to ten days. Under more favourable conditions in the field the life-cycle is complete at a much quicker pace at every stage and there are instances where the period from egg to adult was only twenty-eight days. The larva undergoes five moults in the majority of cases but occasionally six and seven moults have been recorded in which case, however, the larval period has not been proportionately protracted.

(*b*) *The different stages of the Swarming Caterpillar.*—

(*i*) The caterpillar immediately after hatching is a tiny worm and measures 1·1 mm., the head being bigger in size than the body segments. The body is pale whitish in colour, with faint black spots denoting small setae which are isolated and distinct all over the body. The larvae grow to a size of about 2 mm. just before the first moult and are pale green in colour dorsally and pale-whitish ventrally. The five pairs of prolegs are fully developed. The thoracic legs are slender and pale whitish in colour. At this stage the larva has the habit of behaving like a looper and does not feed continuously.

(*ii*) Soon after the first moult, the average size of the caterpillar is 2·5 mm. and it grows to 3-3·5 mm. at the end of the stage. The head shield is darker in tint, and the abdomen is pale green. The small setae are very fine but distinctly visible as arising from the black spots on the body surface. A chitinised prothoracic shield gets more marked and faint longitudinal lines begin to appear on it.

(*iii*) The third-stage larva is 5·5 to 6 mm. long. The body is light green and smooth. The setae and warts are less conspicuous. Pale white longitudinal lines are clearly visible on the prothoracic shield, one on the median dorsal line and two laterally. Pale yellowish white lines appear inter-segmentally on the abdomen. Small blackish or brown colouring appears at the anal end of the lateral lines; this feature appears to be very characteristic of this stage.

(*iv*) The fourth-stage larva is fairly stout in build with its body cylindrical and smooth; the head is smaller than body with a darker green tint; and the body gets the characteristic colouring of the mature larva. The stomata become more distinct and are placed above the ventro-lateral line. The lateral lines and spots also begin to appear more prominent over the body segments; larvae are 10 to 12 mm. long. In some the lateral and median dorsal areas begin to get a greyish brown tinge. Setae and warts are inconspicuous. Fine irregular longitudinal striae begin to appear on the dorsal side of the body, this, however, not interfering with the general colour. The lateral brown bands are irregularly broadened a little at the region of the stomata in each segment.

(*v*) The fifth-stage larva is about 16-20 mm. long and grows to a size of about 35 mm. The body-width across measures 6·5 mm. The head is very much narrower than the rest of the body. The three longitudinal streaks on the pro, thoracic shield are distinct. The dorsal median one is continued upto the metathoracic segment and further behind replaced by a faint greyish yellow median thick band proceeding to the abdomen. The two lateral streaks running longitudinally from the prothorax are continued after the metathorax as two clear lateral yellowish bands. These dorso-lateral lines have in each segment a black lunule or elongated black spots which appear almost as an interrupted black line. Below the line of stigmata, there is a brownish yellow band running from prothorax to the anal segment on each side. The mid-dorsal and lateral areas sometimes appear as pinkish bands. On mesothorax, metathorax and penultimate abdominal segment black eye-like spots are visible in place of stigmata. There are colour variations also. Immediately after the fourth moult the caterpillar is small in size compared to the full grown one and is about 18 mm. with head, prothoracic and anal shields whitish and body pale green in colour. In about one hour the larva grows to 25 mm. nearly, the head and anal shields getting a darker tint. The inverted 'V' mark on the head gets conspicuous in a few minutes, but the central space between the two arms of the 'V' does not change in colour and remains white. This is a particular feature of this caterpillar. The

body lines, the lateral brown bands and intersegmental whitish lines are gradually demarcated; the median dorsal line as a light brown streak later disappears in the general colouring. In some larvae the brown lateral bands turn blackish. On the dorsal border of these bands appear the interrupted black spots in place of the sub-dorsal white streaks. The dorsal median area is brown or grey. The inter-space between dotted line and ventro-lateral line is slightly greenish in some larvae. When full grown, *i.e.* before pupation, the larvae are very stout, plumpy and smooth, with the characteristic dusky grey colour, inter-spersed with dorsal longitudinal line of black markings on the segments. It measures about 35 mm. In natural conditions, the general colouring simulates that of the surrounding soil. The setae are sparse, short and inconspicuous over the smooth body surface. These are slightly more in number and more conspicuous towards the head shield and anal segment. The under-side is greenish, sometimes getting a darker greyish colour of the soil before pupation. The thoracic legs are greenish grey or dusky grey. The prolegs are fairly stout with a slight constriction close to the plants on which the crochets in the form of seventeen to twenty hooks are arranged in a semi circle, the convex end being towards the inner side of the larva.

(c) *Habits and activities of the caterpillar.*—

(i) *In captivity.*—Larvae prefer to feed on tender paddy four to ten days old, or equally well on the grass *Panicum setigerum*. The larvae growing in the latter increase in size more rapidly and show a darker green colour in the early stages. The older paddy leaves over one month's growth are mostly discarded though older larvae after the third moult feed on them in the absence of food. Inside cages wherever eggs are laid the newly hatching larvae straight away reach up-to the tender leaves by crawling or by silken threads. In a big wire gauze cage, when the egg-mass was laid in a corner of the wire gauzed roof and when the food material right below the hatching larvae was drying up, the young larvae exhibited the peculiar habit of crawling along the roof towards a fresh material below and dropping on to the same by silken threads. The swarming tendency is noted even in the first-stage larva. Inside a cage where tender paddy and the grass *Panicum setigerum* were grown simultaneously the larvae collected on the grass blades showing a definite preference to this grass.

(ii) *In the field.*—The larvae hatch out in swarms from the numerous egg-masses in each field. The tiny caterpillars are found crawling out of the egg-masses, in the early hours of the morning, and are very active. They let themselves down in clusters from egg-masses, by means of silken threads and are easily wafted by the slightest breeze to adjacent plants. The larvae which happen to fall on the ground, slowly crawl over to reach fresh plants. In two days' time they distribute themselves on the surrounding plants and usually one or two of them only are found in each plant of five to ten days' growth. The small caterpillar after scraping the green matter in the tip of the leaf rests along the rolled up edges or centre of the tender shoot and is invisible because of the small size

and the greenish colour. In about ten days after hatching the larvae grow to a size of about one centimetre and more, and the crop begins to show a sickly appearance due to the activities of the caterpillars manifested in the form of withered tips and cut leaf blades. In some of the plots without standing water and with a heavy population of caterpillars, these feed on a good number of plants wholesale and the gaps in the tender thick-sown crops are little noticed then. During the early hours of the morning, by wading through the semi-wet plots brushing the plants, a large number of these caterpillars are dislodged and they stick on to the wet skin of our legs. These larvae now begin to feed voraciously and the growth is more rapid. In about another ten days they reach a size of 2½ to 3½ cm. with stout body and active habits. They feed during nights and hide during day amongst cracks in the soil or under earth in bunds. During cloudy days the larvae feed both during day and night and are visible on the plants, the damage to leaves is done at a quicker and surprisingly short interval and the cultivator is brought alive to the situation. The absence of standing water in the early stages of the crop gives them ample facilities for marching in swarms from one field to another for feeding, even crossing bunds and roads. Extensive damage by way of defoliation of the crop becomes possible even in the course of a week where numerous caterpillars are at work (Plate XLV, fig. 6). The caterpillars, if they happen to be in a field with water, cut the leaves and stems to the level of the water and often porch on the exposed stumps. In about four weeks after hatching, the larvae are almost full grown; they leave the plants and seek wet earth in the field or in the bunds for pupation. This caterpillar in almost all its stages exhibits the characteristic trait of bending or curling up into a ring shaped posture (Plate XLV, fig. 8) when disturbed; this is of course the usual feature in all cutworms. The newly hatched larvae are never found on a crop which is over twenty or twenty-five days old, and the caterpillar in any stage is not generally found on a crop over six to seven weeks and very often it has not been found in a transplanted crop.

(*d*) *Moulting and pupation.*—The period from hatching to pupation covers twenty-one to thirty-two days, and usually pupation takes place after the fifth moult. The interval between moults covers three to five days upto the last moult but one, and the last instar is sometimes prolonged, due probably to the manœuvres of the larva in locating a suitable place to pupate. In cases where the moults exceed five, a moult takes place after third at short intervals. The number of moults do not appear to have any relation to the sexes. During the process of moulting the head shield is cast off first. The moulting takes place on the leaves of the food plant, and the moulted skin is often eaten away by the emerging caterpillar. In the early stages the moulting is not easily observed except by the presence of the shed head shield. But after the second moult the larval exuviae are sufficiently big in size, and the moulting process is clearly seen. In the inactive stage just before moult, the larva contracts in size a little, turning slightly black,

The process of moulting observed in second and third-stage larvae is as follows :— The caterpillar lies inactive closely appressed to the leaf blade, along the length of the inner surface of the leaf. The hinder end of the caterpillar is fixed to the leaf by the anal prolegs and the head portion moves slightly. First the head shield is slowly detached and pushed off by the newly formed shield from within. The larva makes movements with its head, and the body skin shrinks and folds back slowly as in a tucked up coat due to the slow forward wriggling movements of the caterpillar. By gradual efforts the whole body comes off the loosened outer skin, leaving the latter behind still attached to the leaf. The cast off head shield is a tiny chitinous transparent integument with the general contour of the head, the setae, eye spots and sutures in tact. The body skin is flimsy, shrivelled in size, whitish in colour and sometimes not entire. The larva immediately after release from the old skin rests for a while to regain vigour, and in the meanwhile the size also increases. The newly formed head is white and the body is pale green or greenish white . The normal colouring and characteristic lines appear in a few minutes. The lateral lines appear as brown streaks from anal end forwards. Towards the close of the last stage, the caterpillar lies in an inactive post for more than a day, sometimes remaining in a curled up contracted condition beneath the soil. The colour changes to dusky grey with the lines and markings faintly indicated. The prolegs become reduced in size and cease to function. The whole larva lies in a curved posture safe in the shelter of a mud cell which it has constructed before pupation. The pupa (Plate XLV, fig. 9) about 16×5 mm. is much smaller in size than the full grown caterpillar. The pupa is at first appearance slightly greenish but later it turns dark brown.

Influence of natural factors on the caterpillar

(*a*) Heavy dashing rains are known to do great harm to growing larva in all stages. Larvae hatching during the hottest part of the year do not appear to reach pest proportions as in the other seasons, and the presence of standing water in the crop is by itself an unfavourable condition for their normal activities.

(*b*) *Disease, etc.*—In some cases during the advanced stage of the larva a bacterial disease sets in and a large number of caterpillars are destroyed. During March 1933 large number of full grown larvae were recorded in a crop of about five weeks' growth with plenty of standing water then in the fields. In about a week's time the plants were all clear of larvae, a large number of the latter being found in the water below, either submerged or floating. The larvae were bloated in appearance, black in colour, and the body-contents were a watery shrinking fluid in one mass inside a loose bag of the thin body skin. The specimens examined by the Government Bacteriologist were found to harbour at least five kinds of bacteria and it could not be ascertained whether the infection caused the death of the larvae or that the bacteria developed after the death of the larvae.

(*c*) *Predators and parasites.*—Crows, storks, ducks, cranes, herons, etc., are

natural predators on these larvae and they devour the caterpillar with great avidity so much so that the presence of fairly grown up caterpillars in an area is invariably indicated by the congregation of these birds in large numbers. In fields with water the larvae perforce remain exposed to view and are removed and destroyed in numbers by these birds.

This pest has been found so far subject to the attacks of the following parasites :—

Hymenoptera—

1. *Charops dominans* W. (Ichneumonidae), Malabar, Coimbatore.
2. *Apanteles ruficrus* Hal. (Braconidae), South Arcot.
3. *Euplectrus Uplexiae* Roh. (Chalcidae), Malabar.
4. *Chelonus* sp. (Braconidae), Malabar.

Diptera—

Of the tachinid flies, the following three are fairly common.

1. *Cyphocera varia* F.
2. *Sturmia bimaculata* H.
3. *Tachina fallax* M.

(*d*) *Alternate food plants*.—Besides being a serious pest on paddy, the caterpillars have been found to thrive on hill grasses along with other cutworms in certain parts of Malabar, Palur and Hosur. The grass *Panicum setigerum* is found eagerly eaten by the caterpillars in captivity. In other parts of India the caterpillar has been found on barley, wheat, maize, etc. [Fletcher, 1920]. The late broods in a locality migrate and feed on a variety of grasses and weeds over the bunds, in the absence of suitable stage of paddy.

(*e*) *Seasonal incidence*.—The pest is usually found on first crop wet nursery and first crop sown broadcast in puddle or semi-wet conditions after first heavy summer rains. The insects appear during different parts of the year under varying periods of sowing in different localities, for instance, in Malabar it is found (*i*) at the *kole* (summer crop) area in Ponnani taluk in January-February, (*ii*) at the South Malabar main crops in May-June, and (*iii*) in the hill grasses in September-October. The second and the third crops if any raised in the same locality or adjacent tracts are not affected and the pest is not known to occur in the same locality more than once in the same year, in spite of the numerical strength of the pest population and the high fecundity of the moths. The pest outbreaks are brought about more by seasonal changes and atmospheric conditions than by food supply.

STATUS AND INCIDENCE OF THE PEST IN RELATION TO *KOLE* PADDY

During the past two years some progress has been made with regard to the study of the general incidence and the conditions under which the pest appears and

multiplies in the field. It has been noticed : (*i*) The pest appears in paddy sown in puddle in slightly water-logged areas or in plots where semi-wet conditions of soil prevail due to defective drainage during sowing time. (*ii*) The moths make their appearance as soon as the paddy germinates and eggs are laid in successive nights. (*iii*) Crop of four to twenty days' growth in ill-drained plots is selected for egg-laying, plots with surface soil dry, or with crop of more age, are left free. (*iv*) The visitation of the moths is usually indicated by the presence of numerous detached wings, scattered all over the field, thereby also indicating that moths gather in batches. (*v*) When sowing operations continue for over a month, batches of moths arrive and serially infect the suitable plots. (*vi*) Largest influx of moths and egg-masses are noted during cloudy nights and on such visits the moths instinctively distributed themselves in fields having the crop with suitable conditions for egg-laying in the midst of a large area of different ages of the crop. It is remarkable that moths appear in numbers, all of a sudden, to infest a large area of hundreds of acres of newly-sown paddy crops while there is practically no vegetation or shrubs on the hills or outskirts nearby. There is a remarkable change in the atmospheric conditions during the period of cultivation from the time of bailing off water and puddling, to the time of a fortnight's growth of the crop, the main features being the heat of the sun and the rising temperature, the high rate of evaporation from the soil, the change of direction and velocity of winds and the increasing rate of transpiration from the growing crops besides any special nascent smell or odour permeating the atmosphere that may be discerned by the insect but little known to the human senses. A reference to this and allied features has already been made in the paper by the authors [Ramakrishna Ayyar and Anantanarayanan, 1935].

Control measures

This aspect of the subject is not dealt with in detail in this paper, the main object here being to describe chiefly the bionomics of the caterpillar. The usual methods of trenching, flooding, sweeping, etc., against this pest are possible only to a certain extent in some areas. Recent studies on dusting with calcium arsenate during the earlier stages of the pest appear to offer some promising means of control as was judged from some recent trials in February last but further work has to be done to confirm this view. In some areas of the Godaveri delta and other tracts where water is generally available flooding the fields or nurseries and sweeping off the caterpillars which float above give some relief. Occasionally sprinkling of kerosene in flooded fields also hastens the death of the caterpillars. In parts of North Malabar there is also the practice of preparing trenches to keep away moving swarms of the caterpillar. In the *kole* area of the West Coast the ryots' practice of keeping the plots completely dry for about a fortnight after sowing and then letting in water allays to a great extent the severity of attack. A more sensible ryot would flood the fields and keep the crop submerged for two or three days and collect and destroy all the floating young caterpillars. A very

common method is the local practice almost everywhere of sweeping the caterpillars by means of a broom into a basket. The utilisation of parasites found in numbers has yet to be studied for its economic aspect. The relative merits of many of these operations can only be properly judged by further trials since the authors believe that at least some of these methods do not go very far in controlling the pest.

Suggestions for future work

It may be added in conclusion that a good deal remains to be done with regard to the following aspects of the problem :—(*i*) Cultural practices, (*ii*) further studies on weather conditions, (*iii*) migration of moths, (*iv*) diseases and parasites for the different stages and (*v*) behaviour of the pest in areas other than *kole* tracts. Finally the authors venture to hope that this connected account of a very well-known pest in spite of its various inevitable shortcomings might help future workers as a preliminary to carry on further intensive studies and confirm or criticise the views contained in this paper.

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THE REFRIGERATED GAS-STORAGE OF FRUITS AND VEGETABLES

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The Food Investigation Board

The above method of storage owes its origin to the work of the Food Investigation Board during the years immediately after the War. Many of the English varieties of apples were found to be very poor keepers in cold storage due to the development of a functional disease, known as 'low temperature breakdown'. The Board were anxious to develop a method which would keep the apples at a slightly higher temperature than that at which the trouble of 'low temperature breakdown' is experienced.

The Board was first established in 1918 as the 'Cold Storage Research Board'. But the wider scope of the work that the Research Board would be called to undertake was soon recognised and the title was, therefore, changed to the 'Food Investigation Board' [1918]. The development of the work of the Board has been very rapid and its importance can be judged from the fact that the Board have at present under their direct control three Research Stations of world-wide fame, namely (1) The Low Temperature Research Station, Cambridge, started in 1922 and fully equipped for bio-chemical and bio-physical investigations at low temperatures ; (2) The Torry Research Station at Aberdeen, started in 1929 for research work on problems relating to storage and transport of fish and fish products ; and (3) The Ditton Laboratory at East Malling, near Maidstone, Kent, for investigating problems relating to the storage and transport of fruits and vegetables.

The Ditton Laboratory

The Ditton Laboratory was established in 1930 as a result of the grant of £45,000 made by the Empire Marketing Board to study the problem of storage and transport of fruit. For this purpose an Experimental Hold, having a capacity of 160 tons, was constructed [Food Investigation Board, 1930]. The laboratory was also equipped for gas-storage research. Specially designed gas-tight cabinets and apparatus for the supply and control of artificial atmospheres of exact composition were installed [Food Investigation Board, 1931].

Origin of gas-storage method

The Food Investigation Board started their work with the terms of reference, "To organise and control research into the preparation and preservation of food".

But the Board made it quite clear in the first year of their existence that "the scientific work of the Board lies not in the production but handling of food" [Food Investigation Board, 1918]. It has also been the policy of the Board throughout "to carry the study of any problem as deeply as possible so that it might contribute its full quota to the body of fundamental science" [Food Investigation Board, 1922]. They have been fully justified in following this policy as can be seen by the origin and the rapid development of the gas-storage method for preservation of foods, specially fruits, apple being the fruit most thoroughly investigated.

In carrying out storage trials with different varieties of apples, the influence of the composition of the surrounding atmosphere, of its content of oxygen, carbon dioxide and water vapour, was an obvious point to begin at and this work was taken up by Drs. Franklin Kidd and Cyril West. The Food Investigation Board in their first report noted "that the composition of air of fruit stores has been suspected of being of importance and this calls for thorough elucidation. Interesting results in stopping the sprouting of potatoes have been obtained and a number of data with various fruits proving the importance of the composition of the air" [Food Investigation Board, 1918]. At that time it was, of course, well known that variations in the proportions of oxygen and carbon dioxide in the atmosphere affected plants no less than animals, but the effects of these variables on the storage life of fruit had not been sufficiently explored. Soon after the investigations had begun in 1918, it was found that the precise effects of variations in the atmosphere on stored fruit depended upon temperature, and the investigation had to be extended to include this variable. As control of the temperature was essential, the gas-storage method was later described as the 'refrigerated gas-storage method.' In 1927, a report describing the general principles and method of gas-storage was published [Kidd *et al*, 1927]. This report cleared the ground for further work and a many-sided development of the method.

Gas-storage

The term 'gas-storage' is used to describe a method in which control of the composition of the atmosphere in the store is the principal feature. Since control of the temperature is also essential, the method has now been more accurately described as 'refrigerated gas-storage' [Kidd *et al*, 1935].

The individual gases that form the atmosphere in which their percentage is regulated are oxygen, carbon dioxide and nitrogen. There are also traces of water vapour and volatile substances given off by fruit. To obtain the atmospheres required, a gas-tight structure is necessary.

Advantages of gas-storage

(1) The outstanding advantage of gas-storage is that the ripening of the fruit at any temperature is slowed down to about half the rate in air at the same temperature. The life of the fruit in store is correspondingly doubled,

(2) Since the temperatures used in the gas-storage of apples are above the limit at which ' low temperature breakdown ' will develop, trouble from this source is avoided.

(3) A specific effect of carbon dioxide is markedly to retard the change in the ground-colour of apples from green to yellow. The almost complete retention of the green colour of the fruit is of great importance with culinary varieties. Carbon dioxide has also the effect of preserving almost unchanged the hardness of the fruit.

(4) Perhaps the most striking advantage of gas-storage, from the point of view of the distributor and consumer, is the long life of the apples after removal from store [Kidd *et al*, 1935].

Application of the method to storage of apples

In the present state of scientific knowledge, it is impossible to foretell how a particular fruit or a particular variety of fruit will respond to an artificial atmosphere of given composition, and it is thus essential to ascertain by empirical storage trials, the exact requirements of the fruit in question before it is safe to commence operations on a commercial scale [Food Ivestigation Board, 1933].

The most important commercial variety of apples in Great Britain is the Bramley's Seedling, and since this apple is susceptible to disease at the low temperatures commonly used for cold-storage, it naturally received most attention. A thorough study of its storage requirements has been made and published [Kidd *et al*, 1930]. The results showed that, with a loss of not more than ten per cent, Bramley's Seedling apples could be successfully stored for thirty-nine weeks at a temperature of 41°F. in an atmosphere in which the carbon dioxide had been raised to ten per cent and the oxygen reduced to ten per cent. This has been followed by another paper [Kidd *et al*, 1933] which gives optimum conditions of storage for Lane's Prince Albert, another culinary variety, at a temperature of 39°F. and a regulated atmosphere of 2·5 per cent oxygen, five per cent carbon dioxide and the remaining percentage being nitrogen. The optimum conditions for the Cox's Orange Pippin, a well known dessert variety, have also been investigated and it was found that the maximum storage life was obtained at 39°F. in an atmosphere containing 2·5 per cent of oxygen and five per cent of carbon dioxide [Kidd *et al*, 1936].

The potentialities of the gas-storage method were quickly grasped by the trade and in 1933-34 there were forty commercial gas-stores and the number has since been increased to about 140. At this stage a small leaflet was published giving in broad details the nature of the method and other factors relating to successful gas-storage of apples [Kidd *et al*, 1935]. Gas-storage trials with apples are now being carried out in Canada, the United States of America and in South Africa. From results already published it would appear that the gas-storage method can be used with advantage for the McIntosh and Yellow Newtown

varieties of apples as grown in Canada and California respectively [Kidd *et al*, 1937].

Other fruits and vegetables

While attention has been concentrated on the immediate application of the method to the storage problems of the apple, the possibilities of its use in the preservation of other fruits and vegetables have been explored. Kidd and West employed this method for the storage of strawberries, as early as in 1919, when they found that strawberries, picked ripe, could be kept in excellent condition for the market for three to four weeks at 1° to 2°C. if maintained in atmospheres of oxygen, soda lime being used to absorb the carbon dioxide of respiration, or in atmospheres containing reduced amounts of oxygen and moderate amounts of carbon dioxide [Food Investigation Board, 1919]. Gas-storage trials of pears at the Ditton Laboratory have shown that though a temperature of 1°C. and an atmosphere of five per cent carbon dioxide and 2·5 to 5 per cent oxygen give a long storage life and keep the fruit in excellent condition, the least costly method of preservation for a limited period is at 3°C. in an atmosphere containing ten per cent carbon dioxide and ten per cent oxygen [Food Investigation Board, 1935]. Further investigations are in progress at this Laboratory. Experiments on the storage of pears in artificial atmospheres have also been reported by Trout [1930, 1932].

Gas-storage trials in England with the most unripe bananas available after overseas transport, have shown that the time taken to reach full ripeness, under gas-storage conditions, is approximately double that taken in air at the same temperature. There have been no experiments on the refrigerated gas-storage of bananas straight from the plantation [Kidd *et al*, 1937].

The available data on the effect of oxygen and carbon dioxide on peaches, papayas, grapes and citrus fruits are very meagre. On theoretical grounds, however, there seems to be no reason why the principle of atmospheric control should not be utilized in the storage of these fruits [Kidd *et al*, 1937].

Barker has tried this method in the case of storage of new potatoes and he obtained a striking retardation of the hardening of the skin by storage in an atmosphere containing twenty per cent carbon dioxide and 7·5 per cent oxygen. Though the skin set more quickly at 45°F. than at 41°F., the former temperature was preferable as sweetening occurred in gas-storage at 41°F. [Food Investigation Board, 1935]. In his experiments on storage of tomatoes he found that decrease in concentration of oxygen or presence of carbon dioxide both retarded the change of colour from green to red. He has further remarked that some form of gas-storage was better than storage in ordinary air. From the data he concluded that the best conditions of storage are five per cent carbon dioxide and five per cent oxygen at 12°C. Higher percentages of carbon dioxide had an injurious effect [Food Investigation Board, 1932].

Beef, pork and bacon

Experiments have also been carried out on the gas-storage of meat. The maximum storage life of beef in chilled condition is forty days. Moran has shown that this period could be doubled if an atmosphere containing ten to twenty per cent carbon dioxide is used at a temperature of 29·5°F. Provided the concentration of carbon dioxide does not exceed sixteen to twenty per cent loss of colour is negligible. Concentrations of carbon dioxide less than ten per cent are required to keep the bloom. It is, however, possible to brighten the colour of meat by increasing the amount of oxygen in the storage chambers. Experimental shipments of beef in chilled and gas-storage conditions have been made from Australia and New Zealand and they arrived in England in excellent condition [Moran, 1933-34].

Callow investigated the possibilities of gas-storage of pork and bacon and found that pork stored in air at 0°C. was spoiled after seventeen days against pork which kept in good condition for this period when stored in carbon dioxide [Callow, 1932]. Smith found that the results of his gas-storage trials of chickens were disappointing [Smith, 1934].

Metabolism of the apple in gas-storage

The prolonged life of apples in gas-storage is now well established. But the actual processes by which the change is effected are not yet fully understood. The effect of carbon dioxide in the case of beef is due to its germicidal power, and the exclusion of oxygen prevents oxidation of the fat [Moran, 1933-34]. But the problem with apples is entirely different. The fruit is living material exhibiting the properties of living plant tissues. A critical study of the metabolism of the fruit in gas-storage has been undertaken. Thus Bracewell and others found little deterioration of the antiscorbutic vitamin when apples were stored either at 1°C. in the air (cold store) or at 10°C. in an atmosphere (gas-store) of approximately ten per cent carbon dioxide, ten per cent oxygen and eighty per cent nitrogen. The effect of storage in carbon dioxide upon the chemical composition of apples has been investigated [Food Investigation Board, 1920]. Parija made a careful study of the effect of different concentrations of oxygen upon the respiration of apples. A minimum production of carbon dioxide was found in three to five per cent of oxygen [Food Investigation Board, 1920]. This fact has an interesting bearing on the prolonged vitality of apples in gas-storage when the oxygen concentration is low.

The broad effect of carbon dioxide in the atmosphere is to decrease respiratory activity. The respiratory activity from the date of picking of the apple to its death due either to fungal invasion or to functional breakdown of the tissues has been carefully studied by Kidd and West. They made the very important observation that at the onset of the senescent period of the apple, there is a stage or a critical period when there is a very sudden rise in the rate of respiration—a

point of great metabolic activity—which they called the 'climacteric'. The climacteric change is accompanied by a rise in chemical activity. Carbon dioxide in the atmosphere, as in gas-storage, was found to postpone the climacteric.

Control of scald

Scald is mainly due to the accumulation of certain volatile products given off by the fruit. From the results of American investigators two chief methods of scald were indicated, (1) the packing of fruit in contact with absorbent substances, and (2) the keeping of the atmosphere moving rapidly. Several absorbents were tried, the most and best easily used is mineral oil sold under various trade names, and refined so as to be practically free from odour. The use of these wraps is essential in commercial gas-stores and suitable wraps are now available on the market. The control obtained by oiled wrappers is generally attributed to the solvent action of the oil on the scald-producing substances, which reduces their concentration to a point below the limit at which damage to the skin can occur [Food Investigation Board, 1932].

A very interesting observation that was made during the course of the gas-storage investigations was the 'group' or 'population' effect of apples on one another [Kidd *et al*, 1930]. It has been found that even if there is a single ripe apple in a group of unripe apples, the effect of the ripe apple is to hasten the ripening of the unripe apples, in other words, to accelerate their climacteric. It was observed that ripe apples had a marked inhibitory effect on the sprouting of potatoes and the germination of seeds, an effect similar to that of traces of ethylene in the atmosphere. Ethylene has now been definitely proved to be one of the constituents of the volatile substances given off by ripe apples and certain other fruits [Gane, 1934].

Control of storage atmosphere

For controlling the storage atmosphere it is obvious that the storage chamber must be more or less gas-tight. The method generally adopted to make a chamber gas-tight is to line its roof and walls with tinned or galvanized sheet steel of about 26 s. w. g. The metal sheets are nailed or screwed to wooden grounds with an overlap of two or three inches, the overlapping joints being sealed by inserting vaseline or some other suitable material before they are fastened together. As a rule, the metal sheeting, in addition to being galvanized, is treated back and front with a dressing of anti-corrosive oil or bitumastic paint. The floor is usually of concrete. Its surface is gas-proofed by coating it with vaseline or with a proprietary composition that has the additional advantage of forming a firm, smooth surface that facilitates thorough cleansing when required. The door usually extends to the full height of the chamber. It has been the practice to make this door in two or more vertical sections. These may be of 5-ply wood, metal covered on both sides, screwed down to wooden door frames, the joints

being sealed with a substance similar to that used for sealing the metal sheeting [Kidd *et al*, 1935].

Fruit, being living material, continually absorbs oxygen from the air and gives off an approximately equal volume of carbon dioxide as a result of respiratory activity. Normal air consists of twenty-one per cent oxygen and seventy-nine per cent nitrogen approximately. Carbon dioxide generated by the stored fruit replaces oxygen in the air so that the sum of the concentrations of oxygen and carbon dioxide always amounts to approximately twenty-one per cent. Atmospheres, in which the sum of concentrations of the above two gases is twenty-one per cent can, therefore, be obtained by restricted and regulated ventilation with fresh air. For this purpose a single adjustable port hole, placed either in the door or in one of the walls is usually sufficient for ventilation. Two such ventilators at different levels set up a through draught and act much more rapidly than a single opening.

For certain varieties of apples atmospheres are required in which the concentration of carbon dioxide is lower than its usual relative value, *i.e.* when the sum of the concentrations of oxygen and carbon dioxide is less than twenty-one per cent. In such cases, means of absorbing the excess of carbon dioxide in the chambers is necessary. Chemical absorption of the excess of carbon dioxide is employed, the process being controlled, either by regulated circulation of the storage atmosphere over the absorbent, or by introducing limited charges of the absorbent, into the chamber at intervals. The absorbent at present employed is caustic soda.

Refrigeration

The capacity of the refrigerating plant should be sufficient to reduce the temperature of the fruit to the temperature of storage without undue delay. Two main methods of arranging the cooling surface, *i.e.* the cooling pipes or grids within the chamber, have been employed. In one, the cooling pipes are attached to the roof, with gutters fitted underneath to catch condensed water. In the other the pipes are arranged in a central tower or duct through which air is drawn by a fan, usually designed so that the flow can be reversed periodically. The fan is driven by a motor, usually placed outside the chamber for ready access and also to avoid unnecessary production of heat. Leakage of gas along the spindle is prevented by a gland. Forced air circulation facilitates uniform and rapid cooling of the fruit. It also helps to keep the atmosphere moving and thus avoid stagnant conditions.

Humidity

Control of the humidity of the atmosphere in gas-stores for apples has so far not been found necessary. Under the storage conditions the relative humidity appears to vary between eighty-five per cent and ninety-eight per cent of saturation.

INSTRUMENTS REQUIRED

Thermometers.—For the successful running of a gas-store for fruit, it is essential to have an accurate record of the actual temperature of the fruit. For this purpose it is necessary to have at least three distant-reading electrical or mercury in steel thermometers which should be placed amongst the fruit inside the boxes and or trays.

Gas indicators.—In a large gas-store consisting of a number of chambers it is advisable to have an instrument that will quickly indicate the composition of the storage atmosphere. The concentration of carbon dioxide is recorded by Katharometer, an instrument which indicates the percentage of the gas on a galvanometer scale. In regulated ventilation method, it is only necessary to record the concentration of carbon dioxide from time to time. For gas-stores which aim at independent control of oxygen and carbon dioxide, an instrument has been designed by Smith and Gane [1935] which quickly indicates the percentages of both these gases.

EXPERIMENTAL METHODS FOR GAS-STORAGE INVESTIGATIONS

In their earlier storage trials, Kidd and West made up the atmospheres of the desired composition in gasometers, each of approximately sixty cubic feet capacity, the oxygen, nitrogen and carbon dioxide being supplied from pressure cylinders obtained commercially. The fruit under investigation was kept in trays in gas-tight containers or cabinets through which the appropriate mixture of the gases was allowed to flow at a slow speed but in sufficient quantity so that there was no accumulation of carbon dioxide of respiration in the cabinets. The cabinets themselves were kept in a chamber the temperature of which could be controlled as desired.

The cabinets were constructed of 5-ply wood with the exceptions of the partitions and fronts which were of Kauria pine. In spite of the most careful cabinet making, the compartments were found far from gas-tight until all the wood work had been treated with vaseline which was melted in with a hot iron. This treatment was followed by a coating of odourless mineral oil. The removable fronts were bedded into position with vaseline to ensure gas tight joints [Kidd *et al*, 1930].

In more recent investigations a new method of obtaining the atmospheres of desired composition has been developed and employed [Kidd *et al*, 1933]. The component gases, oxygen, carbon dioxide and nitrogen are stored in separate gasometers under a small positive pressure. After drying over solid calcium chloride in a drier, each gas flows into mixing headers through flow-meters of simple design, with a needle valve to control the rate of flow. The regulation of the rate of flow of each gas gives the desired composition. No special precautions are necessary to mix the gases after metering, since the delivery pipe is long and the velocities small.

The flow of gas is set to the minimum which will ensure that no appreciable accumulation of carbon dioxide takes place at any time. Approximately one cubic foot of the mixture an hour is passed through each cabinet. This quantity, of course, varies with the temperature of storage. This arrangement gives increased accuracy and flexibility, since alterations to the composition of any mixture can be made at once and with precision. At intervals a sample of the gases going out of the cabinets is collected and analysed.

The gas cabinets are placed in constant temperature rooms. The incoming gases are dried over calcium chloride and then passed through glass tubes filled with glass beads which are moistened by a continuous slow flow of calcium chloride brine of a known concentration which gives the gas mixture the desired humidity.

The gas cabinets which are specially constructed are of sheet iron with welded joints. Each cabinet has a volume of sixteen cubic feet and is fitted with a ' Plymax ' door, held in position by lengths of channel sectioned steel. A perfect gas-tight joint is made by a pneumatic tube fitting in a grove between the door and the cabinet. The inlet tube reaches just near the bottom and the outlet tube is taken from near the top.

The advantages of the above method for experimental gas-storage trials are obvious. Unfortunately, however, such an installation is very expensive but this should not be counted as a barrier in the research investigation of any sort.

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COMMON CONTAGIOUS AND PARASITIC DISEASES OF POULTRY IN INDIA AND THEIR CONTROL

BY

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IN India, with the increasing interest taken by the public in poultry breeding during the past few years, diseases of poultry, especially those of an infectious and contagious nature, have gained prominence. There is no problem of greater importance to the poultry industry than that of disease control. The success or failure of this industry depends largely upon restraining diseases within reasonable bounds. To accomplish this satisfactorily, veterinarians must take a prominent part because without their help proper diagnosis, treatment and prevention of poultry diseases are not possible.

Errors in management, breeding and feeding are so closely linked with disease that they are inseparable. In many cases such errors are the most important factors to consider and overcoming these is of the greatest advantage.

Close inbreeding for high egg production, rapid growth and early maturity without due regard to the size of the egg, general flock stamina, etc., have, in many instances, resulted in poor fertility, weak chicks, lowered constitutional vigour, lowered resistance to disease in general and in some flocks to an inherited susceptibility to certain serious infections. Such unwise intensive methods of breeding have often nullified the results aimed at. Probably it would be more practical and economical in the long run if the breeder eliminated these undesirable factors as carefully as he fixed desirable ones by careful selective breeding even if he had to sacrifice some otherwise valuable birds. This may be a comparatively slow process, but it would result in healthier poultry flocks.

A properly balanced diet, especially with regard to vitamins and minerals, their optimum amounts, ratio and the form in which administered, is essential from the standpoint of deficiency disease, general health and susceptibility to various infections in the flock. A good grass range is a factor of great importance in allowing the birds to rectify their dietary defects. It must not, however, be overlooked that too much forcing for high egg production, early maturity and rapid growth by feeding rations excessively high in animal protein concentrates with other high pressure methods is bound to affect the health of the flock adversely and increase the mortality rate.

Avoiding damp, dusty, insanitary and crowded housing with insufficient direct sunlight and poor ventilation is of great value in the prevention of poultry diseases. Houses should be so constructed that they can be easily moved, where outside runs are used, to ensure proper rotation of yards, which is very essential for the control of parasitic and bacterial diseases.

Diseases of poultry do not respond to treatment as well as those of mammals and generally it is not an economical problem in large flocks to treat individual birds. Our forces, therefore, should be employed mainly towards their prevention and control, for which the following general measures are highly beneficial and they render the specific measures, to be described later under various diseases, more effective :—

1. All errors in general management of the flock should be corrected.

2. Diseased birds should be isolated as soon as detected and healthy ones should be removed to a fresh ground. Badly diseased birds should be killed and all carcases should be burnt or buried deeply and covered with lime.

3. Houses should be cleaned and disinfected thoroughly, with special emphasis on cleaning which enables the disinfection to be more effective. To clean a house properly, all litter, droppings and debris should be removed and burnt or placed on fields that are not to be used as a poultry range.

4. The inside of the house and the equipment should be thoroughly scraped, scrubbed with a three per cent solution of lye (crude soda alkali) in hot water and then sprayed with a five per cent watery solution of cresol or some other suitable antiseptic. The houses should then be lime-washed, the wash containing a quarter pound of carbolic acid per gallon. Brazier's blow lamp's flame can also be used for disinfecting various fittings and equipment. Feed and water utensils should be scalded frequently.

5. A layer of slaked lime should be applied to the infected runs. It is not safe to use these runs for at least two months after the disappearance of the disease.

6. The attendants coming in contact with diseased birds should disinfect their hands, clothes and boots before they approach healthy birds.

7. The use of a mild antiseptic, like potassium permanganate, in drinking water is desirable.

8. Crowded quarters should be relieved. The flock should be divided into small groups, if possible, as this will be of great advantage in dealing with outbreaks of infectious diseases.

9. All newly purchased birds and birds returning from poultry shows should be quarantined for a reasonable period, say, fourteen days,

FIG. 1 Fowl pox nodules on the comb and skin of the head

FIG. 2 Fowl pox diphtheritic lesions on the tongue and palate

FIG. 4. A fowl vaccinated with fowl pox vaccine over the feather follicles of the thigh (only a mild local reaction occurs)

FIG. 3 Mouth cavity of a fowl opened to show the diphtheritic lesions of fowl pox extending into its posterior portion

10. Birds that have recovered from certain infectious diseases, *e.g.* bacillary white diarrhoea, fowl typhoid, etc., are not only uneconomical to keep due to their poor condition and production, but are often chronic "carriers" of the disease. This is one of the most important reasons why it is advisable to rear chicks on a clean ground away from all other poultry and to house the pullets of the current year separate from older birds.

Fowl pox

It is a contagious disease of poultry wide-spread in India, caused by a filter passing virus and characterised by wart-like lesions on the comb, wattles and skin of the head (Plate XLVI, fig. 1), yellow cheesy diphtheritic membranes in the mouth (Plate XLVI, fig. 2 and Plate XLVI, fig. 3) and oculo-nasal catarrh. One or any combination of these lesions may be present. It has been definitely established at this Institute, with the material received from different places in India, that the cutaneous, buccal and oculo-nasal lesions are caused by the same filterable virus which is immunologically identical with the Weybridge strain of this virus. It is, therefore, desirable that every case of the disease caused by fowl pox virus, irrespective of the type of lesions induced and symptoms manifested, should be called fowl pox and terms like roup, avian diphtheria or contagious epithelioma denoting only one type of the disease should be discontinued.

It is highly contagious and the principal method of spread is probably by means of infection through a wound inflicted by pecking and fighting or other mechanical means like the grit causing injury to the buccal mucous membrane.

As regards control, the individual fowl being of a relatively small value and the disease being a highly contagious one, it is advisable to kill all the affected birds, especially when they form a small percentage of the whole flock, and apply the general measures of control, described already.

For prevention, birds should be vaccinated with fowl pox vaccine obtainable from this Institute, which confers in about fourteen days a solid immunity against natural infection and a well marked protection even against artificial infection. The vaccine does not give rise to any constitutional disturbance, loss of condition or, as far as ascertained, interference with egg production.

The best age for prophylactic vaccination is 3½ to 4 months and the vaccine may be inoculated over the feather follicles of the thigh after plucking a few feathers and applying the vaccine with a camel hair brush (Plate XLVI, fig. 4) or it may be applied over an unfeathered area of the leg by scarification with a small scalpel dipped in the vaccine causing breaking of the skin and introduction of the vaccine simultaneously, as in small pox vaccination in human beings.

DOYLE'S (RANIKHET) DISEASE

This disease was first observed and described in 1926 in England. In India, Cooper described it under the title of "Ranikhet disease" in 1931, naming it after the place where it was first observed. It is now found to be wide-spread in India and is responsible for a huge mortality amongst fowls. The disease is caused by a filterable virus, is almost invariably fatal and the most characteristic symptom is respiratory distress.

The wide distribution of the disease, its high infectivity and great virulence render it a serious menace to the poultry industry in India and elsewhere. Its immunological identity with Doyle's disease in England, pseudofowlpest in Dutch East Indies and avian pest in Philippine Islands was established at this Institute. Fowls, ducks, turkeys, pigeons, parrots and certain wild birds, notably crows, are all susceptible to the disease. It is often reported that where fowls are dying in large numbers, the crows in the vicinity are dropping dead and assist in the dissemination of the disease. The causative virus is present in the internal organs and in the discharges from the mouth and cloaca. In the blood it is present in so small a quantity or probably for so short a duration that it is seldom infective in ordinary doses for healthy susceptible fowls.

The natural method of infection is through direct or indirect contact for which the highly infectious nature of the oral and faecal discharges is responsible.

In the majority of cases the symptoms are observed as a result of involvement of the digestive tract, the respiratory organs, the circulatory and the central nervous systems. Only in a small percentage of cases one or more symptoms fail or are only slightly exhibited. The average period of incubation is four to six days and at the onset of the disease there is dullness, weakness, loss of appetite, increased thirst, a gradual rise in temperature which later drops to normal or even below normal. There is profuse offensive stringy discharge from the beak, marked respiratory distress and diarrhoea with yellowish green faeces which soils the feathers around the cloaca. The feathers are ruffled, tail drooping, and the bird seems disinclined to move. There is marked sleepiness progressing on to total somnolence. The weakness of the limbs becomes so marked that the affected fowls may not be able to stand. The colour of the comb and wattles is changed to deep red or violet blue, and oedema of the head, particularly in the region of cheeks, throat and eyelids is noted. Nervous symptoms may prevail in the early stages of the disease simultaneously with the characteristic dyspnoea but usually they occur in sub-acute cases when incoordination of the head and neck, and partial or complete paralysis of the legs and wings are observed (Plate XLVII, fig. 1). The virus seems to have a great affinity for the central nervous system. In the recovered birds some permanent nervous derangement may persist rendering the bird useless for keeping in the stock. In pigeons the reaction exhibited is

FIG. 1. A fowl infected with Doyle's disease virus showing paralysis of legs and wings incoordination of head and neck and dyspnoea

FIG. 2
Proventriculus showing ecchymoses (haemorrhagic spots)

FIG. 3.
Cloaca and a portion of caeca showing lesions of catarrhal enteritis

FIG. 4 A pigeon infected with Doyle's disease virus, showing paralysis of legs and wings

FIG. 5 A crow infected with Doyle's disease virus, showing paralysis of legs and wings

similar to that occurring in fowls except that the paralysis of the legs and wings is an extremely well marked symptom (Plate XLVII, fig. 4). In crows and parrots the paralysis of the legs and wings is also quite marked (Plate XLVII, fig. 5).

On *post-mortem* examination the characteristic lesions of the disease are discrete petechiae or ecchymoses found typically in the proventriculus and are as a rule located on the papillae and near the entrance to the gizzard (Plate XLVII, fig. 2). A localized catarrhal enteritis is not infrequently seen in the cloaca, caeca (Plate XLVII, fig. 3) and duodenum. There is complete absence of any naked eye lesion in the lungs in spite of extreme respiratory distress during life. In very acute and rapidly fatal cases the carcase may appear like that of a healthy fowl.

The above lesions, though quite helpful, are not always sufficient to arrive at a definite diagnosis as in most of the other contagious diseases of poultry. Laboratory aid is essential to arrive at a definite and confirmatory diagnosis. The best procedure is to despatch liver and spleen in fifty per cent glycerine and sterile swabs charged with the buccal discharge from the suspected case to a laboratory, where an emulsion is made with normal saline solution and injected into two healthy susceptible fowls and one or two fowls immune to Doyle's disease. The former will take the infection and die, whereas the latter will remain unaffected. Heart blood is usually cultured to eliminate bacterial infections.

Fowl plague which is caused by a filterable virus and resembles Doyle's disease but has not yet been recorded in India, can be differentiated from the latter by its shorter period of incubation, quicker course, absence of respiratory distress, high infectivity of the blood, lesser degree of contact infection, non-susceptibility of pigeons and immunological distinction.

In the event of an outbreak the only practical method of control known at present is the destruction and proper disposal of the carcases of all the affected birds, thorough disinfection of the premises, removal of all the healthy birds from the infected pens and the addition of an antiseptic to their drinking water, etc., as described under general measures of control. Limited viability of the virus outside the body is a helping factor in its control. The fact that a recovered bird was immune to subsequent attacks of the disease led various workers to prepare sera and vaccines against this pest. The late Mr. H. Cooper found at this Institute that serum from a recovered fowl was highly protective in doses of 2½ to 5 c. c. The injection of the serum followed in 24 hours by an infecting dose of the virus conferred a solid immunity. Since the supply of serum from fowls is limited and expensive, an attempt was made to obtain the antiserum by immunizing donkeys, but without success. Since then a good deal of useful researches have been done on the various aspects of the disease, but as regards the preparation of a suitable vaccine or the discovery of a useful chemotherapeutic agent against this disease the results obtained so far are not so very encouraging.

Fowl cholera

It is an acute, highly infectious disease affecting fowls, turkeys, geese, ducks, guinea-fowl, pigeons, pheasants, partridges and some of the smaller wild birds, irrespective of age, caused by *Pasteurella aviseptica* and characterised by high fever, general septicaemia, *i.e.* the causative organisms circulating and multiplying in the blood, and as a rule rapid death. Rabbits can be infected by artificial inoculation. In very acute cases, which occur mostly in the beginning of an outbreak, birds are found dead with no previous sickness having been noticed. While moving about they may drop down suddenly and die or the course may be only a few hours. Later, when the disease assumes a less acute type, the sick fowls are dull, off feed and show the general symptoms of an acute illness. There is a rise of temperature (109°—112°F.) and they may sit in a droopy manner. The feathers are ruffled and quite frequently the birds appear to tremble. From symptoms of sleepiness they pass on to coma. The comb and mucous membranes are cyanosed, *i.e.* bluish, and there may be discharges from the beak and nostrils. Usually diarrhoea sets in with excrement of a bright yellow or green colour, though often blood-stained. The bird often dies in about three days after exposure to infection.

Outbreaks of a chronic form of fowl cholera are rare. In such cases the bird becomes anaemic, with persistent diarrhoea, swelling of the leg and wing joints containing caseous purulent material, and wry neck may develop due to *Pasteurella aviseptica* affecting the brain from where it can be recovered.

For diagnosis *post-mortem* and bacteriological examinations are essential. On *post-mortem* examination, haemorrhagic inflammation of the intestine and often of the lungs, enlargement and softening of the liver and spleen and petechial haemorrhages on the heart (Plate XLVIII, fig. 1) and liver may be observed. In chronic cases yellowish grey dry patches in the lung, liver and lining of the intestine and cheesy material in the leg and wing joints are found. A film (smear) may be prepared from the heart blood soon after death, stained and examined under the microscope for the presence of the typical bipolar stained organisms, *Pasteurella aviseptica* (Plate XLVIII, fig. 2). Attempts to demonstrate the organism in films prepared from peripheral blood during life may not be always successful. Pipettes of heart blood or material from the bone-marrow, the latter being more likely to be free from *post-mortem* bacterial invaders, may be taken with sterile precautions for cultural examination in a bacteriological laboratory in order to confirm the diagnosis.

For control the general measures, described already, may be applied. The injection of fowl cholera serum is helpful in cutting short the progress of the disease. On farms where the disease is enzootic the birds may be periodically protected with fowl cholera vaccine. Both the serum and the vaccine are prepared and issued with full instructions and dosaged by this Institute.

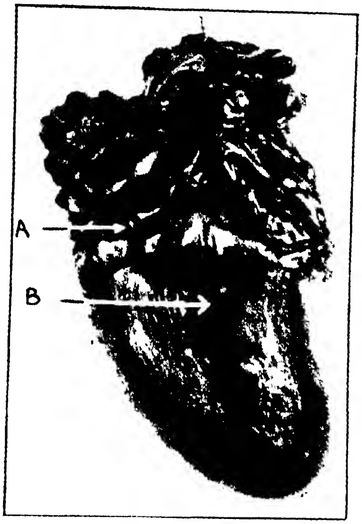

FIG. 1. Heart showing small haemorrhagic spots (A) and a large haemorrhagic area due to fowl cholera (After Gawtkin and Glover)

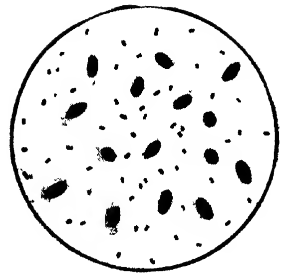

FIG. 2

Pasteurella aviseptica in chicken blood (After Hutyra and Marek)

FIG. 3

Tuberculous liver and spleen of a fowl

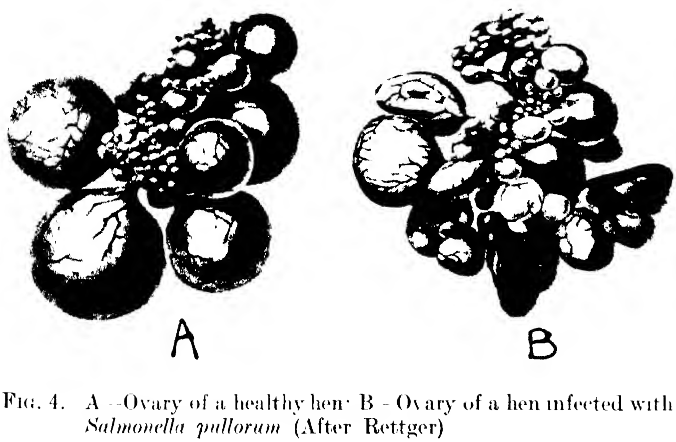

FIG. 4. A—Ovary of a healthy hen: B—Ovary of a hen infected with *Salmonella pullorum* (After Rettger)

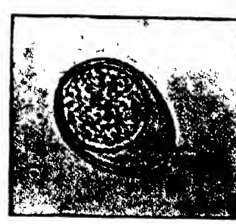

FIG. 5.

Oocyst or fertilized egg of *Eimeria tenella*

Avian tuberculosis

It is responsible for serious loss amongst fowls and other birds, *e.g.* pigeons, pheasants, water fowls, etc., especially when in captivity and is quite common in India. It is commonly seen in adult or nearly adult birds, being a slow and insidious disease and is, therefore, rare in growing chicks. The disease is caused by *Mycobacterium tuberculosis avium*, a member of the acid-fast group of organisms and is highly contagious by cohabitation and spreads through the medium of the discharges.

The disease is characterised by progressive emaciation in spite of good appetite which is best seen in the breast muscles. There is anaemia as exhibited by the pallor of the comb and wattles, general weakness, lameness from affection of the joints and diarrhoea.

On *post-mortem* examination, the lesions are found mainly confined to the digestive tract. Yellow or colourless, friable and cheesy nodules having a fibrous capsule are present in the liver, spleen and intestine (Plate XLVIII, fig. 3). Unlike mammals the lungs are rarely affected.

Diagnosis in a living bird may be arrived at with the aid of clinical symptoms, described above, and a positive tuberculin test done in the skin (intradermally) of the wattle or comb with concentrated avian tuberculin available from this Institute. In a carcase the *post-mortem* findings and microscopic and bacteriological examinations of the suspected lesions are decisive.

Eradication of the disease is best done by destruction and proper disposal of the infected birds and thorough disinfection of the premises. After disinfection the premises should not be occupied for a few months. The best plan is to destroy the older and badly affected birds, test the remainder with tuberculin and destroy the reactors as well. Land, if not properly disinfected, is believed to remain infective for at least two or three years after an infected flock has been killed off.

Bacillary white diarrhoea (pullorum disease)

It occurs naturally in fowls and symptoms of an acute septicaemia are usually only seen in chicks though adults occasionally may exhibit symptoms and die. Some cases have been confirmed in turkeys.

It is caused by *Salmonella pullorum* and is responsible for a heavy loss to rearers of poultry. It is more commonly a disease amongst artificially hatched and brooded chicks than among those which have been hatched and cared for by hens. Consequently its incidence in India is bound to increase with the future development of the poultry industry on modern intensive and extensive lines, although at present it is uncommon.

Infection is principally through infected eggs from a carrier hen although infected incubators, infected brooders and infected young chicks also spread the infection to healthy chicks.

The chicks may die in the shell. Deaths occur from the first day of hatching until the chicks are about three weeks old but the mortality is heaviest between the eighth and twelfth days and may even reach a hundred per cent. The average course of the disease is two or three days. The affected chicks appear sleepy and remain under cover or hen most of the time. They isolate themselves from the rest of the flock and appear indifferent to the surroundings. They become weakened, lose their appetite and their feathers become ruffled and wings droop. There is a progressive loss of weight. Diarrhoea with a white or yellow excrement is common and it mats the feathers around the cloaca. In many cases the chicks are huddled up and present the appearance of being short backed or big bellied. If adults show symptoms, they exhibit diarrhoea and general signs of ill health and die in one to three days. Survivors are always carriers.

In chicks no naked eye lesions are observed on *post-mortem* examination in cases of rapid death, but in others catarrhal enteritis with thickening of the intestinal wall, presence of a semi-solid yellow mass in the caeca, enlargement of the liver and congestion of the lungs may be observed. Yellowish nodules, which may coalesce, are frequently seen in the lungs and are often diagnostic. The walls of the heart may also show these nodules. Adults in acute cases show, in addition to enteritis, small necrotic foci in liver, spleen, pancreas and heart. In carrier hens the lesions are confined to the ovary which contains ova of abnormal appearance besides the normal ones. Instead of being round and yolk coloured they are angular, flattened, reddish green in colour and with long stalks instead of short. This is also a diagnostic feature (Plate XLVIII, fig. 4).

A correct diagnosis of the infection in living birds can be arrived at by the agglutination test. A biological test with 'pullorin', a product similar to tuberculin and used on the wattles in the same way as the latter, has also been used to detect the infected birds. In a dead bird the sure proof of the presence of the disease is the isolation of *Salmonella pullorum* from the heart blood, liver or bone-marrow of the chick and degenerated or even apparently normal ova of the carrier hen.

As a measure of control the breeding stock should be periodically subjected to the agglutination test and reactors eliminated. Eggs, chicks or adult birds should be purchased only from sources known to be free from this disease. Purchased birds should be isolated till they have passed the agglutination test. The incubators, brooders and premises should be kept clean and occasionally disinfected. A satisfactory method of disinfecting incubators is to use formaldehyde gas liberated by 1·5 c. c. of formalin to 1 gramme of potassium permanganate per cubic foot, with fifteen minutes' exposure.

Fowl typhoid

It is an infectious disease of fowls, young turkeys, guinea-fowl and pheasants affecting the blood and internal organs and is distributed all over the world,

It is common on insanitary farms and its causal agent, *Shigella gallinarum*, was first discovered by Klein in 1886 in Wales. In India, it was first definitely recognised and reported in 1931 by Cooper and Naik of this Institute and is known to be wide-spread.

The common method of infection is by ingestion of infected food and water, although it may be transmitted to the chicken through the medium of the egg.

Affected birds show the usual signs of illness like dullness, drowsiness, fever (110°-112°F.), loss of appetite, general weakness and paleness of the visible mucous membranes, comb and wattles. The symptoms are not characteristic except perhaps a sulphur-yellow coloured diarrhoea. The usual termination is death, though chronic cases sometimes end in recovery. The course is 1 to 10 days or longer.

On *post-mortem* examination no typical lesions are seen. Catarrhal enteritis is generally found, but not always. The liver is enlarged, congested and friable and if a bronze discolouration is present it is indicative of the disease. Other organs are congested and the heart muscle may show white areas of round cell infiltration.

Laboratory aid is essential to arrive at a correct diagnosis. The infected birds can be detected by means of the agglutination test. Although it is a septicaemic disease the organism is not demonstrable in blood smears. Cultural examination is necessary and cultures should be made from the internal organs, *e.g.* liver pulp and bone-marrow, on suitable laboratory media.

In the event of an outbreak, segregation, disinfection, along with destruction and proper disposal of the infected birds as described already under the general measures for control should be undertaken. Birds recovered from fowl typhoid react positively to agglutination test against both *Shigella gallinarum* and *Salmonella pullorum* antigens. So, by eliminating the reactors to the agglutination test against *Salmonella pullorum* antigen one gets rid of both the diseases from the farm. Good results are claimed for vaccination with cultures of the causal organisms killed by heat, alcohol or ether.

Avian coccidiosis

It is a disease of the intestinal tract of birds and is caused by minute protozoan parasites known as coccidia, taking an acute course in young chickens but assuming a chronic form in adults which act as carriers. *Eimeria tenella* and its allied species which are responsible for coccidiosis in the fowl may also infect the turkey, peacock and pheasant but rarely the duck. The pigeon harbours

a different coccidium but the life-cycle of all these parasites is essentially the same and therefore the control is carried out on similar lines.

This parasite needs only one host and on passing out from the intestine with the droppings it passes a part of its existence as an oocyst or fertilized egg (Plate XLVIII, fig. 5) on the ground. Under suitable conditions of temperature and humidity it ripens and a number of parasites are formed inside the envelope. On ingestion by a bird this envelope is broken down by the digestive juices and the parasites which are freed make their way to the epithelial cells of the intestinal wall, where they multiply asexually leading to a heavy infestation of the intestine of the bird. The parasite also undergoes a process of sexual reproduction which results in the formation of oocysts which are passed out with the droppings on the ground where they ripen in two to fourteen days and are then ready to infect a new host.

It is transmitted by means of feed, water and soil that have become contaminated with the droppings of adult carrier birds. Infection may be brought in with new birds or eggs and the organisms may be carried by running water, dust, attendant's shoes, flies, etc.

In acute cases, the affected chicks become listless and dull. In early stages they eat ravenously but later their appetite is lost and they mope in dark corners. A greyish white diarrhoea is common and the droppings are often blood stained. Frequently affected chicks die within two or three days. In chronic cases the affected birds become unthrifty, losing flesh until actually emaciated. They eat ravenously in spite of which they remain unthrifty and lose flesh.

On *post-mortem* examination, in acute cases, the characteristic changes are usually observed in the caeca which become enlarged with thickened opaque walls and have a hard core of yellowish material frequently mixed with blood. Minute white spots may be seen on the inner surface of the intestine. In chronic cases the lesions are scanty but thickening and ulceration of the caecal walls can frequently be noted.

Diagnosis is made by the detection of the parasite in the scrapings taken from the intestinal wall and examined under the microscope. There is a marked daily fluctuation in the number of coccidia passed out in the faeces, therefore the examination should be carried out at least twice or thrice on different days. In chronic cases the disease must be differentiated from tuberculosis and other wasting diseases.

Isolation, disinfection and other general measures of control, described already, should be enforced. It is always advisable to kill off the survivors of an outbreak as they frequently remain unthrifty and carriers, and replace them by healthy fowls. Clean dry ground and dry quarters should be provided. Frequent, daily or at least every other day, cleaning up of the droppings which is the real

danger is essential so that the parasites contained in it are taken away from the birds before they become infective for them. Chicks should be reared on a clean ground. Birds and eggs should be obtained from known healthy flocks and the dipping of eggs in a suitable disinfectant is also recommended by some. Build up the resistance of the flock with a well balanced nutritional diet. Good results have been obtained in the treatment of less severely affected birds with iodine and buttermilk but these are not specific. Buttermilk increases the hydrogen-ion concentration (acidity) of the caecal contents which affords protection against the parasite. This state can be maintained by feeding the birds continuously on it. (*To be continued*).

CABBAGE APHIS—*SIPHOCORYNE INDOBRASSICAE*—AND ITS CONTROL WITH HOME-MADE NICOTINE SPRAY

BY

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CONTENTS

I. Introduction

Cabbage Aphis is a common pest wherever cabbages or related cruciferous plants are grown. The intensity of the attack varies from year to year, but in certain years it is responsible for serious losses in crops like cabbage, cauliflower, *knol-khol*, *mogri* (a kind of radish), etc. It is with a view to control this pest that the present investigation was taken up and the following is a short account of work done on the Poona Agricultural College Farm and round about during the last three or four years.

Usually two species of aphids (1) *Myzus persicae* Sulz. (Radish Aphis) and (2) *Siphocoryne indobrassicae* Das (Indian Mustard Aphis) are found attacking

this crop and both of them go under the common name of 'Cabbage Aphis.' *Myzus persicae* is a polyphagous species and has got about thirty-five different host plants. The other species *Siphocoryne indobrassicae* is the real Cabbage Aphis, and is more or less restricted to this crop. The account given below mainly refers to this latter species, while the observations on control refer to both. The description of the Cabbage Aphis (apterous female) given by Das [1918] is as follows:—

(1) Dull greenish colour.

(2) Two median rows of shining spots on the dorsal side.

(3) Antennae dark coloured except at the base.

(4) Slight meal on the body.

(5) Cornicles dark tipped, longer than the cauda.

II. Life-history

Siphocoryne indobrassicae is the commonest aphid on cruciferous plants during the winter and spring months, *i.e.* from October to March. The first appearance of this aphis is noticed on cabbage seedlings early in October and usually coincides with the fall in the minimum temperature to 60°F. or below. Aphids in general are known to produce dimorphic forms—alate and apterous—and their method of reproduction is either sexual or parthenogenetic. Sexual generation has not been noticed so far in the Deccan and consequently no eggs are found. Males are absent. The forms met with are only females which are either alate or apterous. Initial infection starts with the appearance of alate females (in the seed-bed, in October) which shortly begin to multiply viviparously. When such infested seedlings are transplanted in the field, the multiplication proceeds on a large scale and both winged and apterous forms are produced in quick succession. Dissemination takes place by means of these alate females. Aphis population reaches its highest point in the month of February. In March the number begins to fall and the aphis practically disappears, to re-appear in the following October. How it passes its life during this intervening period is under investigation.

III. Growth and reproduction

This aphis was reared in two ways (1) by growing it in the open on leaves of potted plants and (2) under controlled conditions on leaves in Petri dishes. Freshly born young ones were taken and placed separately on leaves and observations were made from day to day. The nymphs feed and grow by casting four to five moults. After six or seven days the nymph becomes a full-grown mother and begins to give birth to young ones parthenogenetically. The young ones produced were counted and removed every day. Some of these were found to develop into pupae and become winged. These winged forms are also females

and reproduce parthenogenetically. The rate of reproduction can be judged from the figures of young ones produced by apterous females given in Table I.

TABLE I

Serial No. of aphis	Date of starting reproduction	Period of reproduction (days)	Number of young ones produced
1	2nd Dec. 1932	34	97
2	19th Jany 1933	30	47
3	23rd Jany. 1933	41	102
4	5th Jany. 1934	26	38
5	5th Jany. 1934	32	76
6	5th Jany. 1934	34	87
7	5th Jany. 1934	26	85

IV. Seasonal variation in population

In order to observe the seasonal variation in aphis population, counts were taken from three leaves of three different plants regularly at an interval of ten days.

From these counts it was seen that the population steadily rose from November and reached its highest peak in February after which it suddenly fell.

V. Nature and extent of damage

Direct damage is caused principally by the withdrawal of sap and injury to the tissues. When present in large numbers the aphids markedly reduce the size of the leaves which get wrinkled and curled. In addition to this direct damage, serious loss is done by the secretion of the honey-dew which gives the plants a dirty appearance and reduces their market value. [Petherbridge and Mellor, 1936].

In order to assess definitely the damage done to the crop by the aphids, two plots (about ten *gunthas* each) were taken. One of these was twice sprayed with Black Leaf 40, while the other was left entirely unsprayed. In order to know the variation in the population on account of spraying, regular counts of aphids were taken every ten days from three leaves from three different plants (Table II).

TABLE II

Date of examination	Number of aphis		Remarks.
	Sprayed area	Unsprayed area	
14th Dec. 1935	274	473	Spraying on 15th Dec. 1935.
16th Dec. 1935	140	510	
26th Dec. 1935	151	635	
28th Dec. 1935	23	836	Spraying on 27th Dec. 1935.
7th Jany. 1936	35	961	
15th Jany. 1936	51	973	
27th Jany. 1936	115	1019	
6th Feby. 1936	237	1105	
16th Feby. 1936. . .	301	1204	

From the above figures it may be seen that the number of aphis is far less in the sprayed area than in the unsprayed one. This was achieved by two sprayings only.

The out-turn in the sprayed and unsprayed plots was as shown in Table III.

TABLE III

Kind of the plot	Number of heads	Out-turn in lbs.
Treated plot	685	2388
Untreated plot	454	1024

Even calculating for the same number of heads, *i.e.*, 454 heads in both the cases, the out-turn in the treated plot was 1582 lbs. as against 1054 lbs. in the unsprayed plot.

VI. NATURAL ENEMIES

Predators.—*Chrysopa* has been noticed in the early stage of the crop. Three species of Lady-bird Beetles and their grubs have been found to feed on aphids on different crops from August till March and seem to be very active towards the end of the season.

Parasites.—Two hymenopterous parasites :—One a *Chalcid* and the other an *Ichneumonid* were observed to be active from January onwards. These attack the apterous forms which consequently turn brown in colour, become swollen and appear like small shining seeds. By the time the aphis is dead, the larva of the parasite nearly completes its life and pupates inside. After completion of the full period, the parasite emerges by boring a round hole on the back of the aphis. The percentage of parasitisation has been found to vary from five to eight per cent, and hence the parasites are not effective as a control.

VII. Control measures

During the first year of the investigation (1932-36) the following insecticides were tried and the kill percentage obtained is given in Table IV.

Table IV

erial No.	Name of the insecticide	Strength of the insecticide	Kill per cent
1	Fish-oil-resin soap . . .	1/2 lb. to 4 gallons of water.	59·8
2	Kerosene emulsion . . .	Stock solution diluted 8 times.	69·6
3	Derrisol	1 in 800 parts of water.	100·0
4	Black Leaf 40	1 in 800 parts of water.	100·0
5	Cyanogas dust . . .		100·0
6	Sulphur dust		0·05

The kill percentage was determined by actually counting the number of dead and live aphids from three leaves after twenty-four hours. From the above figures it can be seen that sulphur dust has no effect on aphids, while Derrisol, Black Leaf 40 and Cyanogas have proved to be the best. Out of these, Derrisol is not now manufactured and hence is no longer available. Cyanogas is found to produce some withering effect on leaves and is, therefore, rejected. Black Leaf 40 is thus the only material which gives very satisfactory results.

Black Leaf 40 is a highly concentrated commercial product prepared from tobacco and contains forty per cent of nicotine sulphate. It is an effective insecticide against aphis but is very costly and not within the easy reach of the village farmer. On account of its prohibitive cost and non-availability, the use of Black Leaf 40 is, therefore, out of the question from the point of view of the village farmer.

Less concentrated solutions than Black Leaf 40 should prove equally satisfactory, the only essential condition being that the final diluted spray should contain not less than 0·05 to 0·06 per cent of free nicotine [Mason, 1929]. An idea, therefore, arose in the mind of the writer to see if it could be possible to prepare an equally effective nicotine spray from the tobacco waste locally available.

VIII. Home-made nicotine spray

Tobacco has been known for a long time as one of the most useful materials for preparing a contact insecticide. But the tobacco insecticides prepared according to the method mentioned in some entomological text-books failed to give good results, because on analysing the final spray they were found to contain only 0·02 to 0·03 per cent of nicotine, which is obviously far less toxic than what is required for an effective kill as mentioned before. The low nicotine content in the final spray was due to its over-dilution. The fact that the tobacco preparation if over-diluted becomes weaker in strength and less effective was proved by actual trials. A tobacco insecticide (stock solution) of known nicotine content was diluted in different proportions and it was found that the kill percentage varied inversely with the dilution (Table V).

Table V

Name of the insecticide	Dilution by addition of cold water	Kill percentage obtained
Tobacco	1/4 part	95 to 97
Extract	1/2 part	85 to 93
Stock solution	One part	78 to 80
Containing 0·063 per cent of nicotine	Two parts	67 to 68

From the point of view of the Indian farmer the first requisite for a good tobacco insecticide is to get the right kind of tobacco which will be sufficiently rich in nicotine, will be cheap and also be easily available in villages. The writer has come across such a type of tobacco material in Vakhars at Nipani in the Belgaum district of the Bombay Presidency, known locally as *dhus*. This was analysed by the Agricultural Chemist to Government, Poona, and was found to contain 2·3 per cent of nicotine. This material does not, by storing in an ordinary gunny bag, deteriorate and nor does it vary in its nicotine content from year to year. Being a waste product this tobacco (*dhus*) is locally used for manuring. It is also available in large quantities from Nipani alone, the yearly estimate varying from five to six thousand bags—each bag containing about 150 lbs.

The method of preparing a nicotine spray from this is as follows :—

" Take one pound of tobacco waste and soak it in two gallons (=twenty times its weight) of cold water for twenty four hours. Then strain the extract through a piece of cloth and add to it an equal quantity of cold water before use."

This method of preparation was determined after several trials. It was also found that soaking in hot water or the addition of soap to the extract does not help in any way the effectiveness of the spray.

Tobacco waste is also available in the tobacco factories in Gujarat, but it is not so rich in nicotine as that from Nipani, as it contains only 1·14 per cent of nicotine. The extract obtained by the above method from this material contains 0·05 to 0·06 per cent of nicotine and hence no dilution is necessary. The spray prepared by the above method has been found to be extremely effective against aphids as it always gives about ninety-five to ninety-seven per cent kill and is also very cheap. In Poona the cost of preparing four gallons of spray from the tobacco waste from Nipani has come to only half an anna as against three or three-and-half annas from Black Leaf 40.

IX. Summary

1. Cabbage Aphis is a serious pest of cabbage and other related cruciferous plants and the loss due to the attack of this pest is about fifty per cent.

2. It is controlled by nicotine insecticides the only condition being that the final spray should contain 0·05 to 0·06 per cent of nicotine in it. Greater dilution weakens the strength and reduces the kill percentage.

3. The writer has been able to prepare a very efficient and cheap nicotine spray from the tobacco waste available from Nipani (District Belgaum, Bombay Presidency).

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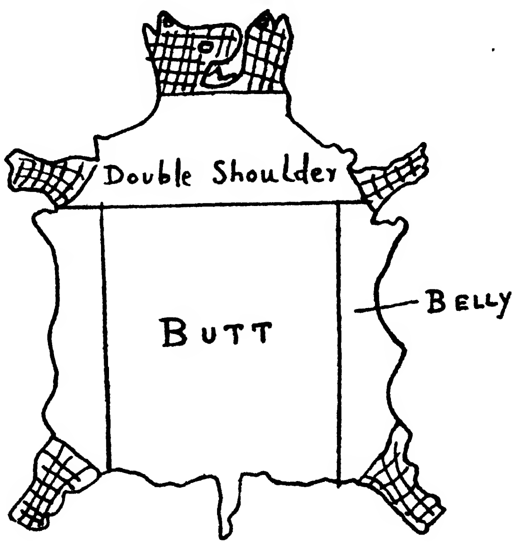
NOTES

WHEN BRANDING MAY BE DONE WITHOUT DETRIMENT TO THE HIDE

THE diagram given below is reproduced from the *U. S. Dept. Agric. Farmer's Bulletin, No. 1055,* entitled ' Country Hides and Skins, Skinning, Curing and Marketing ' for the purpose of illustrating where branding may be done on the body of an animal without injuring the hide. It is the outline of a hide of good pattern and trim. The areas that may be branded are shaded.

For details regarding skinning, etc., the bulletin mentioned above may be referred to.



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THE WORLD'S GRASSLAND CONGRESS, 1937, ABERYSTWYTH, ENGLAND

IN his Presidential Address to the World's Grassland Congress, July 1937, Professor Stapledon said that over an enormous area of the world grass is the foundation of the agricultural industry and young succulent grass the prince of feeds. It was first of all necessary to classify our grasslands, and then to work and plan on the basis of clearly defined natural regions.

The proper use of grass was a matter of systems of farming, of the right implements, the right fertilisers, and pre-eminently of the right seeds. More than that it was a matter of usage and customs, systems of land tenure, methods of marketing, and a hundred other things, tackled on a regional basis.

He regarded the question of mapping of prime importance (Mr. Vryner Jones pointed out in his address of welcome that Wales was the first country to have her grasslands completely mapped), and the grazing animal as more important than either soil or climate.

Legumes (clovers) were of supreme importance. " Make the conditions suitable for the legume and manage the sward to favour the legume as well as to feed the animal and everything else will be easy " he said.

He did not hold with using fields continuously as pasture or continuously as hay meadows. The cheapest way of ensuring soil fertility was to plough up at regular intervals all grasslands that would take the plough. Before ploughing always graze as hard as possible for some months to impregnate the soil with urine and excrement.

" It is ", he said, " in the study and utilisation of grass and of the lands that but seldom or have never felt the weight of the plough that the future of the human race lies ". (Reprinted from *The Farmer and Stock-breeder*, July 20, 1937)

ABSTRACTS

Cytological studies in paddy varieties. B. L. SETHI. (*Ind. J. Agric. Sci.* **7**, 687)

CHROMOSOME numbers, their behaviour at meiosis and the differences in their morphology have been studied in a number of paddy varieties representing diverse characteristics. Despite great diversity in the plants handled and the wide geographical range dealt with, all types are consistent in possessing twelve and twenty-four as their haploid and diploid number of chromosomes respectively. The unusual grouping of chromosomes at homotypic metaphase at diakinesis as well as paired arrangement of somatic chromosomes lend support for regarding *Oryza sativa* as a secondary polyploid, having originated through the natural hybridization of species, in the sub-families closely related to *Oryzeae*, possessing five and seven chromosomes. The chromosomes of different types show definite morphological variations and the somatic complement of each variety has been analysed with regard to their morphological details. From a consideration of results, the strains can be regarded as different forms of the same species; the variability is not large enough for regarding them as distinct species. A positive correlation exists between meiotic irregularities and sterility. Different types have also been grouped according to their meiotic behaviour of chromosomes. It is possible to conceive that varieties like T 3, T 75, *pasai* and *Frecoce allorio* with regular meiosis had an earlier existence in this world, whereas T 5, T 21, T 23 and T 94, having slight irregularities in meiosis, originated subsequently from the existing forms through natural crossing and more recent origin is of T 2, T 26, T 110 and T 131 showing serious irregularities. (*Author's abstract*)

A note on the cyto-genetics of *Ricinus communis* L. R. H. RICHHARIA. (*Ind. J. Agric. Sci.* **7**, 707)

RICINUS COMMUNIS L. shows at meiosis ten bivalents which segregate regularly. No nucleolus was observed from diakinesis onward. Earlier stages were not studied. The maximum number of secondary associations observed at I and II metaphases is five, thus *R. communis* appears to be a secondarily balanced polyploid with the provisional gametic constitution as **AAA BB CC DD E,** which gets full support from the genetical analysis showing duplicate and triplicate factors. (*Author's abstract*)

Observations on the milling of rice in the United Provinces. R. L. SETHI, B. L. SETHI, T. R. MEHTA, AND P. S. GUPTA. (*Ind. J. Agric. Sci.* **7**, 713)

A METHOD of pre-treating rice before milling (*sela*-making method) has been described. It is in some respects akin to parboiling. A comparison of the *sela*-making and the *kachcha* (raw) hulling methods, both of which are important industries in west United Provinces, was made. Besides, hulling properties of different improved varieties and of different appliances of hulling were tested. The cooking trials revealed the superiority of the *sela* rice over the *kachcha* rice. (*Authors' abstract*)

A note on a few experimental observations in the Rice Research Station, Berhampur (Madras). M. B. V. NARASINGA RAO. (*Ind. J. Agric. Sci.* **7,** 783)

I. EXPERIMENTAL PLOT SIZE

FROM an uniformity trial conducted with 512 small 5 ft. × 5 ft. plots with transplanted paddy crop using various combinations, giving different shapes and sizes, it was concluded that a plot 20 ft. × 5 ft. repeated six times with eight treatments to a block was adequate for differentiating between merits of treatments. There were no significant differences in the standard errors between long narrow and square or nearly square plots. In conformity with findings of previous authors it was advantageous by elongating the plots along the fertility gradient and compounding the blocks at right angles to it.

II. CORRELATIONS OF SOME CHARACTERS ON YIELD IN RICE

Total and partial correlations and multiple regression equations between yield and each of the three characters, *viz.* number of tillers per plant, mean length of earhead and number of grains per earhead were calculated in four important paddy varieties. Number of tillers bore the highest correlation with yield, both total and partial, followed by number of grains per ear and length of earhead. Under no-manure conditions the number of grain and length of ear exert a little higher influence than under manured conditions. (*Author's abstract*)

Agricultural meteorology: The prediction of the minimum temperature on clear days at selected stations in India. M. NARASIMHAN AND L. A. RAMDAS. (*Ind. J. Agric. Sci.* **7,** 745)

IT is found that the minimum temperature of a day during the clear season can be expressed as a function of the maximum temperature and the water-vapour content of the air during the previous afternoon. The cooling of the air layers near the ground during clear nights decreases with increase in the water content of the atmosphere and in the maximum temperature. Regression equations have been worked out for nineteen selected stations in India using the data of 100 clear days in each case. These equations are of the form :

$$N = b_x X + b \quad V + \text{constant}$$

where N is the minimum temperature, X and V are the maximum temperature and the vapour pressure, respectively, of the previous afternoon and b_x and b are constants. It is found that the values of R are all significant and lie between 0·93 (for Calcutta) and 0·72 (for Lahore, Agra and Karachi). From these equations the values of N may be calculated for any clear day.

On applying the 'Performance test' to the results in the case of Calcutta (maximum $R = 0{\cdot}92$) and Lahore (minimum $R = 0{\cdot}72$) the equations are found to satisfy the test very satisfactorily, showing that the samples of 100 observations used for calculating the regression formula are quite representative of conditions at each station during clear weather.

These results are of interest in connection with the prediction of minimum temperature on clear days during the winter season. (*Authors' abstract*)

Studies on the dissociation of *Bacillus cereus*, an organism frequently associated with plants affected with mosaic disease. N. V. Joshi and S. C. Dutt. (*Ind. J. Agric. Sci.* **7**, 763)

An organism was found to be practically constantly associated with different kinds of plants, *e.g.* tomato, tobacco, *bhindi*, etc., which were suffering from the mosaic disease. The technique of isolation consists in (*a*) sterilising the outside of the cut pieces of stems and petioles of leaves by 1 : 1000 mercuric chloride solution, under reduced pressure, (*b*) washing the sterilised pieces with sterile water and placing them on sterile agar slants and (*c*) selecting only such growth as occurred after an incubation period of seven to ten days sometimes extending to twenty-three days. Any tube in which growth occurs before seven days' incubation is rejected as being contaminated.

Inoculation with cultures obtained in this way into healthy plants gave positive results on many but negative ones on a few occasions. Nothing definite can be said as to whether this associated organism is the real cause of the mosaic. Further, even assuming that it is the cause of mosaic it is not as yet possible to explain the capricious behaviour of the cultures in reproducing the mosaic in a large percentage of the inoculated plants on some occasions while at other times only a small percentage of the inoculated plants show symptoms of mosaic.

It was considered, therefore, desirable to study this organism in greater detail before entering into a discussion of (*a*) the debatable question whether this organism is concerned in causing mosaic or (*b*) the reasons why its cultures fail to reproduce mosaic on inoculation into healthy plants, assuming of course, without having proved it as yet, that this organism may be the real cause of mosaic. The organism has been tentatively identified by us as *B. cereus* which showed pellucid dots on agar cultures, the cause and origin of which dots had not been so far satisfactorily explained, some considering the dots to be the result of a bacteriolytic principle or bacteriophage present in the agar cultures, others considering them to be " the places where the culture is in virus form ".

We have been unable to demonstrate the existence of any bacteriolytic principles as all the methods which we used to test the existence of the lytic principle gave always negative results.

We next tried the technique recently developed by Hauduroy, Hadley and others for the study of the dissociation forms of bacteria and succeeded in finding that the organism, isolated by us from mosaic-affected plants, dissociates into several variants which can be stabilised, that is, isolated and kept in culture without changing to other forms or reversion to the original forms.

After comparing these dissociative forms with the variants obtained from other organisms we have been able to give their equivalent names to some of the forms isolated by us. They are as follows :—

S (smooth) form with pellucid dots in its agar culture is a spore former, and motile by peritrichic flagella. It dissociates spontaneously into all the forms named below and is, therefore, the original or mother form of all the other variants.

(1) Swollen big coccus form, called *A* by us, but not yet given any equivalent name.

(2) Coccal rod form, named *B* by us, also not yet identified with similar form of any other organism.

(3) Small cocci equivalent to Hadley's *G* type of Shiga dysentery bacillus.

(4) *R* (rough) form is non-sporulating, non-motile and without pellucid dots in its agar culture. This form has not been previously isolated from *B. cereus* by any other investigators who were searching for it. Its cultures are otherwise similar to the *S* form described above. This form dissociates in broth cultures only into the forms *B* and *G* described above but has not dissociated into swollen big coccus form or the filterable forms as yet.

(5) Filterable forms which are found in a stabilised condition when the broth cultures of *S* form are filtered after eight days incubation. If filtered before this time the filterable forms have a tendency to revert to the *G* form and later to the original mother form *S*.

None of these variants show pellucid dots in their pure cultures on agar except the *S* form, but we have been able to demonstrate that the associated growth of *R* with either of the variants coccal rod form (*B*) or coccal form (*G*) gives rise to the pellucid dots similar to those observed in the cultures of the *S* form, probably because of the difference in transparency and refraction of the different kinds of colonies produced by these variants. Associated growth of the other variants swollen big coccus or the filterable forms with *R* form does not give rise to pellucid dots. Associated growth of any of the variants other than *R* among themselves has also not shown any pellucid dots. The cultures of *S* or smooth form always show the pellucid dots. These dots can now be accounted for by the rapid and spontaneous dissociation of this sporulating mother form S into other variants in agar cultures because when among the dissociated cells of different kinds the colonies of *R* cells grow in close proximity to the colonies of coccal rod forms (*B*) or coccal forms (*G*) the pellucid dots will easily arise as has been already demonstrated by actual experiment.

The reason why the *R* form culture does not show the pellucid dots is that it gives rise to the dissociative forms *B* and *G* only in liquid broth cultures and not in agar culture. It may not be out of place to suggest that there is a possibility of some of these several variants singly or in combination with others reproducing mosaic symptoms more uniformly than has been possible hitherto with cultures of the smooth variant. At least we consider that the question whether they do so or fail to reproduce mosaic symptoms is worthy of further study. (*Authors' abstract*)

The bird enemies of the Cotton Leaf-roller (*Sylepta derogata* Fb.) at Khanewal (Multan, Punjab). M. Afzal Husain and Hem Raj Bhalla. (*Ind. J. Agric. Sci.* **7**, 785)

The importance of birds in the control of insect pests is well known. A serious outbreak of *Sylepta derogata* Fb. (the Cotton Leaf-roller) occurred in the American cotton fields near the forest area at Khanewal. The birds of the locality were shot, their stomach contents examined and their economic status determined. Besides poultry, thirty-six different species of birds, belonging to seventeen families, ate *Sylepta derogata* Fb. caterpillars. (*Authors' abstract*)

A new disease of *Eleusine coracana* Gaertn. P. R. Mehta and S. C. Chakravarty. (*Ind. J. Agric. Sci.* **7**, 793)

A new disease of *Eleusine coracana* was observed at Benares. Affected plants were stunted in growth, pale and tufted in appearance. The internodes were often very short and from the uppernodes there frequently developed numerous sterile lateral shoots. The most characteristic feature of the disease was the formation of numerous white adventitious roots from the aerial nodes. Diseased plants failed to develop a fertile shoot, and if they did it was sterile. There was no sign of premature death nor was tillering affected. Microscopic examination revealed the presence of intercellular bacteria in the phloem of root and stem. (*Authors' abstract*)

A new Cecidomyid pest of linseed in India. Hem Singh Pruthi and H. L. Bhatia. (*Ind. J. Agric. Sci.* **7**, 797)

For the last few years the larvae of a minute Cecidomyid fly, which has proved to to be a new species, *Dasyneura lini* Barnes, were observed doing damage to the flower buds of linseed at Pusa during February and March. In 1933 the damage was about fifty per cent. During 1934 and 1935 the pest appeared in the fields but the incidence did not go above twenty per cent. The pest was closely studied in 1936 when the incidence went up to forty-seven per cent in some varieties (Flax) during the last week of February and first week of March. Early in 1937 linseed fields at Karnal were examined and were found to be also infested by this fly. Thus it appears that the pest is widely distributed in India. The eggs are laid singly or in small batches of three to five eggs in concealed positions in the folds of the calyx of young green buds. On hatching the young larvae go inside the bud and suck juices of the internal organs of the bud. As a consequence of the attack the corolla gets slightly decolorized and crumpled, the essential organs become withered, buds open partly or do not open at all and the setting of seed does not take place. Thus a good deal of loss is caused to the cultivator.

The duration of various stages in the life-cycle in the laboratory at Pusa with average maximum and minimum temperatures of 77·4° and 72·0° F. respectively was :—

Egg, eighteen to twenty four hours ; larva, four to nine days and pupa, three to six days. The larvae when full-grown crawl down or drop on the ground and spin cottony cocoons under soil within which they pupate. The cocoons are found superficially in the soil. Under laboratory conditions sometimes even naked pupae were obtained, which gave rise to normal flies.

The pest breeds from the beginning of January up to the middle of March, the breeding being most active after the middle of February. About the middle of March all varieties of linseed are mature at Pusa. At this time the full-grown larvae of the pest instead of pupating normally as described above, form thin silken covering under soil and enter a quiescent stage. It is very probable that the larvae pass whole of the hot weather in this stage and revive and form pupae and adult soon after the rainy

season or in autumn. Evidence is furnished to show that the pest infests *Cajanus indicus* before it appears on linseed.

A detailed description of the various stages in the life-history of the pest is given.

It appears that the relative incidence of the pest on various varieties of linseed is very much dependent on the time of their flowering. The varieties flowering about and after the middle of February, when the pest breeds most rapidly, were found to suffer most. (*Authors' abstract*)

Studies in Fusarium wilt of sann-hemp. I. The physiology and biology of *Fusarium vasinfectum* Atk. B. N. Uppal and N. T. Kulkarni. (*Ind. J. Agric. Sci.* **7,** 413)

A short account of wilt in sann-hemp is given. The symptoms of wilt have been briefly described. The morphological and cultural characters of the fungus, which is considered to be a strain of *Fusarium vasinfectum* Atk., have been described. There is no evidence of selective parasitism in the fungus since isolations secured from widely separated localities in the Bombay Presidency proved almost equally pathogenic on sann hemp.

The sann hemp wilt fungus makes the best vegetative growth in culture at 25 to 30° C., and wilt also makes the maximum development in a similar range of soil temperature, thus indicating a close parallelism between the development of the disease and the vegetative growth of the parasite. Wilt is also very destructive to sann-hemp in soil of low moisture content, but, since soil temperature does not vary widely under the normal range of field conditions during the monsoon, soil temperature generally operates as the limiting factor in determining the severity of sann-hemp wilt.

Fusarium vasinfectum on sann-hemp produces the enzymes emulsin, lipase, erepsin, trypsin and amidase, but there was no evidence that the fungus could utilise cellulose or starch.

It has been shown that the growth of the fungus in culture media containing inorganic nitrogen effects the reduction of nitrates to nitrites, but no such action was noticeable in media with organic nitrogen such as sodium asparaginate. The filtrates of twenty-four to twenty-eight days old cultures on Richard's solution were found to contain nitrites in quantities ranging from 0·0015 to 0·0022 mgm. of nitrogen per c.c. of solution. Further, they were found to possess toxic properties : these were not destroyed by boiling but their toxicity was reduced by the dilution of the filtrate.

Fusarium vasinfectum on sann-hemp readily passed to *Crotalaria anagyroides, C. striata* and *C. usaramoensis* in cross-inoculation tests, but invariably failed to infect *Cajanus indicus* and cotton.

Experimental evidence has been produced that Fusarium wilt in sann-hemp is seed-borne. Wilt is normally transmitted externally on the seed, a very small percentage of which may also harbour internal infection as dormant mycelium. Infected seeds are often shrivelled and non-viable, and such seeds may carry infection internally and are an important source of wilt transmission. (*Authors' abstract*)

A note on a variety of *Salmonella enteritidis* isolated from pigeons. J. F. SHIRLAW AND S. GANAPATHY IYER. (*Ind. J. Vet. Sci. & Anim. Husb.* 7, 231)

1. IN a batch of pigeons inoculated with experimental pigeon-pox virus at the Imperial Veterinary Research Institute, Mukteswar, deaths from a septicaemic disease occurred and from the heart blood of such pigeons a Gram-negative bacterium was isolated.

2. The cultures from the diseased pigeons were, on their cultural and pathogenic merits, subjected to a detailed study.

3. Agglutination, cross-agglutination and agglutinin absorption tests conducted with authentic types of the genus *Salmonella* suggest a marked serological relationship with two stock strains of *S. enteritidis* isolated from animals at this Institute. (*Authors' abstract*)

Some digestibility trials on Indian feeding stuffs. Part XI. Cotton seed cake as a cattle feed. P. E. LANDER AND LAL CHAND DHARMANI. (*Ind. J. Vet. Sci. & Anim. Husb.* 7, 225)

FEEDING trials carried out with cotton seed cake produced from 4 F American cotton seed without any preliminary delinting and decorticating have shown this to be a highly nutritious and economic food, comparing more favourably than the whole cotton seed and showing a very satisfactory comparison with *sarson* and *toria* cakes.

The digestibility figures for all the ingredients were high; the albuminoid ratio was 1 : 3·1, and the cake possessed eighteen lbs. of digestible protein per cent. The price of the cake compared with *sarson* and *toria* cake, per starch equivalent, was two pies, as against 7·1 for each of *sarson* and *toria* cake. Expressed in terms of price per pound of digestible protein the cost of the cotton seed cake based on current Lyallpur prices is 6·7 pies as against 17·6 and 18·2, respectively, for *sarson* cake and *toria* cake. (*Authors' abstract*)

A preliminary report on canine schistosomiasis in the Madras Presidency. M. ANANT NARAYAN RAO. (*Ind. J. Vet. Sci. & Anim. Husb.* 7, 109)

THE first case of schistosomiasis in a dog in India was reported by Rao and Ayyer in 1935 and the present author records another case indigenous to the Madras Presidency. This dog lived most of its life in Gudiattam, a village in the North Arcot District, where it was allowed to swim in ponds frequently. The clinical history of the case is that it developed repeated attacks of dysentery. The microscopical examination of the faeces revealed a large number of ova of schistosomes which closely resembled those of *S. suis*. *S. suis* was discovered in pigs that came for slaughter in Madras from North Arcot District, hence it seems possible that many of the ponds in that

district are infected and the dog having picked up the infestation from one of these. It is not known if this schistosome is widely spread in India though there is evidence to show that it exists in the Central Provinces and Bengal.

A detailed description of the ovum and the miracidium is given in the paper. It is compared with that of some other species and the differences noted. (*Author's abstract*)

On the treatment of *Babesia bigemina* infection in cattle in India. J. A. IDNANI. (*Ind. J. Vet. Sci. & Anim. Husb.* **7**, 273)

A LARGE number of failures resulted in the routine practice, in the control of *Babesia bigemina* in cattle with trypanblue, during rinderpest work. The parasites were observed to appear in the peripheral circulation of experimental animals within three to five days after inoculation with virulent blood, and that rinderpest virus obtained from such animals could not be issued for use with safety in serum-simultaneous inoculations against rinderpest. Experiments were undertaken to test the efficacy of maximum doses of trypanblue tolerated by bulls, but this failed to produce sterilization of blood of artificially infected animals. A series of tests was carried out to ascertain whether such failures could be attributable to deterioration in the potency of the particular stock of trypanblue used, or to the fact that a "trypanblue fast" strain of *B. bigemina* was being dealt with in these trials. Both these contentions were, however, ruled out as a result of comparative trials, with a fresh stock of trypanblue upon an untreated strain of these parasites. The drug was then replaced by another proprietary preparation Akiron R which yielded very satisfactory results. The minimum curative dose of this drug was determined to be 1 c.c. of a five per cent solution per 100 lbs. body-weight. The curative effect of Akiron R proved to be sufficiently lasting but it was valueless as a prophylactic. (*Author's abstract*)

The effect of high protein feeding on milch cows. P. A. SESHAN. (*Ind. J. Vet. Sci. & Anim. Husb.* **7**, 289)

AN experiment has been made to study the effect of an increase in the level of protein feeding on the quality and quantity of milk yield of cows.

Besides their requirements for maintenance, one group of six cows was fed a production ration containing 20·7 per cent of digestible crude protein, while that of the higher protein group, also consisting of six similar cows, contained 29·1 per cent of digestible crude protein.

No difference was observed between the two groups either in food consumption, milk yield or body-weight.

The milk from the high protein group showed a slight tendency to be richer in non-protein nitrogen, ash and lime contents. (*Author's abstract*)

Urinary calculus in the rabbit. M. Y. MANGRULKAR. *I. C. A. R. Misc. Bull.* No. 15.

THE occurrence of an unusually large and rounded calculus in the urinary bladder of a rabbit is reported. The finding is of interest as "stones" in smaller laboratory animals are not commonly met with and if small may be overlooked at *post-mortem* examinations. In the present case the attention of the author was drawn to the condition by the distension of the bladder with about 20 c.c. of blood-tinged urine. The calculus was 2 cm. in diameter, and weighed 7 grammes. It had a distinctly laminated interior and consisted mainly of calcium carbonate. (*Author's abstract*)

REVIEWS

The Cacao Industry of Trinidad*. By C. Y. Shephard. Copies may be obtained on application to the Editor, 'Tropical Agriculture', Imperial College of Tropical Agriculture, Trinidad, B. W. I.

Professor Shephard has made a very thorough and detailed economic survey and has presented in his series of publications a very clear picture of the economic conditions of the cacao industry in Trinidad.

It seems to be suffering from troubles that have had to be faced and overcome in many other planting industries. He deals with what is perhaps one of the most important and fundamental troubles, the distribution to owners, etc., of estates of larger profits than the capacity of the estate justifies, with the consequent impoverishment of the estate. This is an oft-told tale and the answer to the problem with which the cacao industry is faced seems to be as Professor Shephard suggests in the amalgamation of estates into limited liability companies; a procedure that has proved beneficial in other planting industries.

It would seem, however, that if regular and systematic progress is to be made, one of the first requirements is that the industry be organised as a whole. Such organisation must result in a pooling of knowledge and the formulation of a far-sighted financial policy calculated to enable an industry to withstand the effects of fluctuating markets and outside competition. It, at the same time, provides the necessary organisation for maintaining systematic and continuous scientific investigations of its various problems. The cacao industry appears to have lagged very considerably behind in this respect, for many of the planting industries such as coffee, rubber, sugar, tea, etc., have already well-established scientific institutions of their own. This seems to be an urgent need for cacao in Trinidad.

Professor Shephard points out the very important factor of soil. It is of interest to note that the good soils seem to possess a high carbon/nitrogen ratio, the poorer soils having a lower ratio.

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*I. The Cacao Industry of Trinidad. Some Economic Aspects. Series II. A Financial Survey of Estates during the Seven Years 1923-24 to 1929-30. Pp. 30+2 Appendices+9 Tables +2 maps + 43 Figs. (Reprinted from "*Tropical Agriculture*", Vols. XIII, 11 and 12 and XIV, 1-5). Price 3/- post free.

II. The Cacao Industry of Trinidad. Some Economic Aspects. Series III. An Examination of the Effects of Soil Types and Age on Yield. Pp. 50+4 Appendices +25 maps + 46 Figs. Series IV. Recommendations for Improving the Efficiency of Estates. Pp. 22+2 Appendices. Price 4*s*. 6*d*. post free.

Manuring does not appear to have been used except to a very small extent to correct soil deficiencies although it is stated that recent experiments have shown the value of suitable manures, but little or no advantage seems to have been taken of this.

Cultural methods appear to be of a traditional order and it would seem are accepted without experimental evidence of their efficiency.

Pests and blights are referred to, but Professor Shephard appears to consider that other factors are of much greater importance at the present time although the high percentage of vacancies in fields from unrecorded causes seems to suggest that possibly diseases may be playing an important part in the present unsatisfactory state of many fields.

The use of shade trees seems to be of general practice but it is somewhat surprising to find that two varieties of *Erythrina* which both possess serious drawbacks are the only trees generally grown. No attempt appears to have been made to establish those leguminous trees which, by symbiotic assimilation of nitrogen, add through their leaf-fall to the nitrogenous wealth of the soil. In tea in North East India for instance, the growing of *Albizzia stipulata* amongst tea is equivalent to the annual application of 30 lbs. of nitrogen as a readily available manure measured in terms of the increased tea crop.

Professor Shephard, I am glad to read, deals in no uncertain manner with one of the greatest difficulties on plantations, namely elimination of non-profitable fields.

The necessity for the removal of plants that are not maximum profit producers is now only being glimpsed in some planting industries other than cacao in Trinidad.

The maps given show that throughout the various fields on the various soils high-yielding trees are scattered at random and it would seem that there are great possibilities for increasing the crop per acre with careful selection of planting material, the necessary care and attention being given at the same time to insure the successful developments of the trees.

It seems evident that it is very desirable to obtain the new planting material by vegetative propagation from known high-yielding bushes rather than from seed. This is the procedure adopted in several of the planting industries at the present time.

This careful and thorough investigation of the cacao industry of Trinidad should prove to be of great benefit to that industry provided it receives the very careful study that it needs and deserves.

Professor Shephard in dealing with the present problems of the cacao industry of Trinidad has dealt with troubles that seem to be fundamental to planting industries until they have reached such a stage of development that estate policies are determined largely by scientific knowledge. [P. H. C.]

Forest Research in India, 1935-36. Part I. The Forest Research Institute. Price Re. 1/6 or 2*s*. 3*d*. (Delhi : Manager of Publications, 1936).

THIS Report gives an account of the activities of the various departments of the Forest Research Institute, Dehra Dun. There are five sections, *viz.* Sylviculture, Botany, Entomology, Economics and Chemistry, and each is further subdivided for the detailed study of different subjects. The policy laid down by the Institute was that of close co-operation in the matter of research between the Central Institute and the provinces. A three-year programme was laid out which was circulated to various provinces for their opinion and remarks. Various items suggested by the provincial departments were included in the programme. As is evident from the Report a very useful work of great practical utility is in progress in different sections and results of economic importance have been obtained. The requirements of industry are closely studied and research work planned accordingly. Regeneration and management of moist tropical forests continued to receive special attention and as this is a subject which can only be studied on tour in collaboration with provincial research and territorial officers, the Sylviculturist made an un-official visit to Malaya in this connection. A start was also made on the much needed modern textbook of Indian sylvicultural system and the book was expected to be out in October 1936. The statistical staff was engaged in the useful work of preparing stand tables for *Chir* pine and volume tables for *Sissu* which will be useful for work in the provinces. An intensive study has been made of the Indian species of *Terminalia* and other plants. 2636 specimens were received from various sources and incorporated in the Herbarium, and 689 specimens were distributed to various herbaria on an exchange basis. An increasingly large number of specimens (1629) sent in by Forest Officers and others from all over India were identified and advice on technical matters given. In mycological research much progress was made in the investigation of various parasitic rusts.

The biology of 161 species of hymenopterous and dipterous parasites was published as a first step for the utilisation of these natural agencies for the biological control of insect pests. Successful work was done in the prevention of borer attack on newly felled logs and converted timber. The pests of ply-wood factories were investigated and remedies were found which would enable Indian-made teak chests to be put up on the market with a guarantee of immunity from borer damage.

Ten thousand soft-wood sleepers of the North-Western Railway were treated with the new wood preservative Ascu for a durability trial. The treatment was 50 per cent cheaper than creosote-crude oil treatment. Ascu-treated wooden poles were also utilised for hydro-electric transmission lines. Some Indian States installed a few of the new type of pressure plant for this treatment designed by the Institute. Another important feature of the year's work was the promotion of relations between the Institute and the paper mills of India. The paper mills

allotted certain definite items of research to the paper pulp section of the Institute and willingly contributed to the expenses of the work.

The chemical section continued the work on the examination of Derris species, and other plants likely to have insecticidal properties. It was found that Derris roots of average quality containing about 2·5 per cent of rotenone are available in certain areas of Assam. Encouraging replies were received to the enquiries regarding the commercial possibilities of fat from certain plants of the natural order *Laurinacea* as a source of lauric acid, which forms the base for sodium lauryl sulphate, considered superior to soap in many aspects, one firm demanding the fat to the extent of five to ten tons per month. The Report is comprehensive, readable and useful. [R. L. S.]

Proceedings of the Association of Applied Biologists, October 1936. (The University Press, Cambridge. Price to non-members 1*s*. 7*d*.)

THIS is a particularly valuable collection of papers on 'The Problems raised by the Woolly Aphis of the Apple' by members of the staffs of the East Malling Research Station and the John Innes Horticultural Institute read at a general meeting of the Association in London on 9th October, 1936. Since there were difficulties in the way of the usual methods of attack of the Woolly Aphis, the use and value of immune root-stocks specially that of Northern Spy as suggested by Professor Theobald had been investigated. It was found that the immune Northern Spy was by no means universally satisfactory as a root-stock. This fact naturally led on both to a study of the possible causes of its lack of efficiency and also to the search for other immune root-stocks. Since the field of choice was very limited the breeding of new immune varieties offered the most hopeful alternative and for this end it was necessary to devise a technique for testing seedlings in quantity for their immunity. This might possibly be approached not only entomologically but from a chemical or physiological standpoint. The need then arose to test these new immune root-stocks for their horticultural value in the nursery and orchard. The development and present stage of these investigations are outlined in the following seven papers given in the publication under review—

I. The Northern Spy as a Root-stock. By R. G. Hatton, C.B.E., M.A. (Oxon.), D.Sc. (Lond.), V.M.H.

II. The Root System of Northern Spy. By W. S. Rogers, M.A., Dip. Hort. (Cantab.)

III. The Control of Woolly Aphis. By R. M. Greenslade, B.Sc., A.R.C.S.

IV. Breeding Immune Root-stocks. By M. B. Crane.

V. Entomological Technique. By A. M. Massee, D.Sc. (Lond.), F.R.E.S.

VI. Pomological Selection of the New Root-stocks. By H. M. Tydeman.

VII. Studies on Possible Causes of Immunity. By W. A. Roach, D.Sc. (Lond.), A.I.C.

The notice of all horticultural workers is drawn to this excellent set of papers, available at the very modest price of 1*s.* 7*d.* [R. L. S.]

***Premi Kisan* (An Agricultural Drama).** By MD. HYDER HASAN. Leaflet No. 18 of the Agricultural Department of His Exalted Highness the Nizam's Government, Hyderabad (Deccan)—Government Central Press, Hyderabad-Deccan, 1937.

THE object of this drama is to introduce to the public the activities of the Agricultural Department in general and to induce farmers and others to adopt improved methods of agriculture, gardening, poultry keeping, etc., and to show to the educated agriculturist (*e.g.*, agricultural graduates), that they can benefit by following the profession which they have learnt more than by looking for Government service. This drama of *Premi Kisan* was staged on the 24th January 1935 at Hyderabad and was found to be a successful display, being very much appreciated by the public. The original was in Urdu. The present publication is the English translation.

Raj, the hero, is the son of a farmer and is an agricultural graduate. He fails to obtain Government employment. His father is angry for having spent so much money on his education and for his condemning the old methods of agriculture and practising modern ones. The father therefore turns him out of the house. Raj is in love with the daughter of his maternal uncle Subba. The uncle refuses to give his daughter in marriage to Raj but agrees to reconsider the proposition if Raj proves himself a successful farmer. Kurmaiyya, a well-to-do land owner, also loves the same girl and it is decided to give the girl to the man who makes greater success of farming and grows better crops. Although Kurmaiyya had more wealth than Raj and tried his best, yet for want of the adequate knowledge he failed to compete successfully with Raj. Raj starts farming with the advice of the officers of the Agricultural Department and makes a success of it. The father and the uncle both are pleased and his marriage to his sweetheart is settled. The use of the drama as a means of agricultural propaganda is not new but this is the first full-length agricultural play we have seen printed. [R. L. S.]

NEW BOOKS

On Agriculture and Allied Subjects

Nematodes Parasitic in Animals. By Lapage, Geoffrey. (Methuen's Monographs on Biological Subjects.) Pp. x+172. (London : Methuen and Co., Ltd., 1937). 4*s*. 6*d*. net.

The Life of the Honey-Bee. By Parnwell, E. C. Adapted from 'The Lore of the Honey-Bee' (Tickner-Edwardes). (Simple Science in Simple English Series). Pp. 52. (London : Oxford University Press, 1937.) 6*d*.

Productive Sheep Husbandry. By Coffey, Walter C. (Farm Manuals.) Third edition, revised. Pp. xxxii+479. (Philadelphia and London : J. B. Lippincott Co., 1937.) 12*s*. 6*d*. net.

Britain and the Beast. Edited by Clough Williams-Ellis. (London : J. M. Dent and Sons, Ltd.) 10*s*. 6*d*.

An Introduction to Weather and Climate. By T. Glenn. Pp. 373, 9×6, illustrated. (McGraw-Hill Publishing Co., Ltd., Aldwych House, London W. C. 2.) 18*s*. net.

Gardens of Europe. By G. A. Jellicoe Blackie. (W. H. Smith and Sons, Strand House, W. C. 2.) 12*s*. 6*d*.

Iris Culture for Amateurs. By. R. E. S. Spender and L. F. Pesel. Country Life. (W. H. Smith and Sons, Strand House, W. C. 2.) 5*s*.

Economic Planning in Australia, 1929-36. By W. R. Maclauren. (London : P. S. King.) 15*s*. net.

Capital, Wages and Profit or Loss. By E. C. Van Dorp. Pp. 290. (London : P. S. King.) 12*s*. 6*d*.

Ancient Geography of India—Major-General Sir Alexander Cunningham—Edited with notes, etc. etc. by S. N. Majumdar Sastri (Chuckervertty, Chatterjee & Co., Ltd., Booksellers and Publishers, 15 College Square, Calcutta.) Rs. 15.

PLANT QUARANTINE AND OTHER OFFICIAL ANNOUNCEMENTS

PLANT Quarantine Regulations and Import Restrictions relating to the following countries have been received in the Imperial Council of Agricultural Research. Those interested are advised to apply to the Secretary, Imperial Council of Agricultural Research, for full particulars.

1. Plant Importation Rules, 1936, of the Federated Malay States
2. Plant Importation Rules, 1936, of the State of Johore
3. Plant Importation Rules, 1351, of the Government of Kedah
4. Plant Importation Rules, 1932, of the Government of Kelant
5. Plant Importation Rules of the State of Trengganu
6. Plant Importation Rules of the Government of Perlis
7. Ordinance No. 13 of 1936 amending the Plant Pest Ordinance and the Legal Notice No. 102 of 1936 of Colony of Seychelles.
8. Plant Protection Ordinance of Tanganyika Territory (Ordinance No. 9 of 1937)
9. Plant Quarantine Import Restrictions. United States of America. Nurserymen and Quarantine

Summaries prepared by the United States Department of Agriculture, Bureau of Entomology and Plant Quarantine, of :—

10. Plant-Quarantine Import Restrictions of the Republic of Peru
11. Plant-Quarantine Import Restrictions of the Republic of Argentina (revised
12. Plant-Quarantine Import Restrictions of Fernanda Po and Spanish Guinea
13. Plant-Quarantine Import Restrictions of Central America
14. Plant-Quarantine Import Restrictions of the Kindgom of Egypt
15. Plant-Quarantine Import Restrictions of the Territory of Southern Rhodesia
16. Plant-Quarantine Import Restrictions of the French Zone of Morocco
17. Plant-Quarantine Import Restrictions of the French Colony of Algeria
18. Modification of Pink Bollworm Quarantine Regulations
19. Plant-Quarantine Import Restrictions of the Kingdom of Rumania
20. Plant-Quarantine Import Restrictions of the Republic of Argentina
21. Plant-Quarantine Import Restrictions of the Republic of Turkey

22. Plant-Quarantine Import Restrictions of the Tanganyika Territory
23. Plant-Quarantine Import Restrictions of the British Colony of Bermuda
24. Plant-Quarantine Import Restrictions of the Nyasaland Protectorate
25. Plant-Quarantine Regulations of the Republic of China
26. Japanese Beetle Quarantine (Revision of Quarantine and Regulations)
27. Modification of Japanese Beetle Quarantine Regulations
28. List of Plant Pests intercepted in entering United States Territory during the period 1st July 1935 to 30th June 1936
29. Service and Regulatory Announcements of United States Department of Agriculture for the period January-March 1937
30. Plant-Quarantine Import Restrictions of the Dominican Republic
31. Plant Quarantine Import Restrictions of Surinam (Netherlands Guina)
32. Plant-Quarantine Import Restrictions of the Colony and Protectorate of Nigeria including the Cameroons under British Mandate
33. Plant-Quarantine Import Restrictions of the Federated Malay States (British).

Personal Notes, Appointments and Transfers, Meetings and Conferences, etc.

Imperial Council of Agricultural Research

Rai Bahadur Ram Lal Sethi, M.Sc., B.Sc. (Agri.) (Edin.), M.R.A.S., I.A.S., has been appointed to be Assistant Agricultural Expert, Imperial Council of Agricultural Research, with effect from the 9th August 1937.

Mr. Jaikaran Nath Ugra, M.A., LL.B., Deputy Collector, United Provinces, has been appointed Officer on Special Duty in the office of the Agricultural Marketing Adviser to the Government of India, with effect from the 22nd July 1937.

Imperial Institute of Sugar Technology

Mr. C. W. P. Vander Meyden, Professor of Sugar Technology, Imperial Institute of Sugar Technology, has been granted leave from the 7th to 29th May 1937, with permission to affix Sunday the 30th May 1937, and again leave on medical certificate from the 8th to 30th June 1937.

Indian Central Cotton Committee

Mr. R. H. Hill, M.A. (Cantab.), officiating Director of Agriculture, Central Provinces and Berar, has been nominated by the Government of the Central Provinces and Berar to be a member of the Indian Central Cotton Committee as the representative of the Central Provinces Agricultural Department, *vice* Mr. J. C. McDougal, resigned.

The Governor-General-in-Council has been pleased to appoint Mr. H. B. Rajdev, Deputy Director of Agriculture, Karnatik Division, Hyderabad State, to be a member of the Indian Central Cotton Committee, as a second representative of the Government of His Exalted Highness the Nizam of the Hyderabad State.

The services of MR. P. H. RAMA REDDI, M.A., B.Sc. (Agri.), B.Sc. (Forestry) (Edin.), I.A.S., Secretary, Indian Central Cotton Committee, Bombay, have been replaced at the disposal of the Government of Madras, with effect from the 13th August 1937. From the same date MR. C. J. BOCARRO, M.A., Assistant Secretary, Indian Central Cotton Committee, has been appointed to hold charge of the current duties of the post of the Secretary, Indian Central Cotton Committee, in addition to his own duties.

Indian Lac Cess Committee

The Central Government have appointed KHAN BAHADUR MANEKJI MERWANJI MULLNA, O.B.E., Pleader, Balaghat, nominated by the Government of the Central Provinces and Berar to represent the lac cultivators, as a member of the Governing Body of the Indian Lac Cess Committee.

The Central Government have appointed MR. GOPAL DAS GUPTA, nominated by the Calcutta Shellac Brokers' Association to represent the lac brokers and shellac brokers in Calcutta, as a member of the Governing Body of the Indian Lac Cess Committee, *vice* MR. H. B. NEMANI, resigned.

The Central Government have appointed MR. J. T. YOUNG (of Messrs. Angelo Brothers, Ltd.). nominated by the Bengal Chamber of Commerce to represent the shellac manufacturing industry, as a member of the Governing Body of the Indian Lac Cess Committee, *vice* MR. W. F. DINES, resigned.

The Central Government have appointed MR. A. METAXA (of Messrs. Ralli Brothers, Ltd.,) nominated by the Bengal Chamber of Commerce to represent the shellac export trade, as a member of the Governing Body of the Indian Lac Cess Committee.

Imperial Veterinary Research Institute

Consequent on the grant of leave to MR. J. F. SHIRLAW, M.R.C.V.S., officiating Veterinary Research Officer in charge of Serology, MR. R. L. KAURA, M.R.C.V.S., Assistant Serologist, Imperial Veterinary Research Institute, has been appointed

to hold charge of the current duties of the post of Veterinary Research Officer in charge of Serology in addition to his own duties, with effect from the 4th July 1937, until further orders.

Madras

MR. P. H. RAMA REDDI, M.A., B.Sc. (Agri.), B.Sc. (Forestry) (Edin.), I.A.S., Secretary, Indian Central Cotton Committee, Bombay and appointed Director of Agriculture, Madras, in relief of RAO BAHADUR D. ANANDA RAO, has been granted leave on average pay for twenty-five days with effect from the 13th August 1937, the date from which his services have been replaced at the disposal of the Madras Government by the Government of India.

MR. R. W. LITTLEWOOD, N.D.A., I.A.S., Deputy Director of Agriculture, Live-stock, has been granted leave on average pay for three months and five days and in continuation leave on half average pay for eight months and twenty-five days from the 7th September 1937 or date of relief.

MR. D. G. MUNRO, B.Sc. (Aberdeen), Deputy Director of Agriculture, has been granted an extension of leave on half average pay for five months from the 1st August 1937.

Bombay

RAO SAHEB G. L. KOTTUR, Cotton Breeder, Southern Maratha Country, Dharwar, has been granted leave on average pay for one month with effect from the 10th August 1937.

The services of the following officers of the Indian Veterinary Service and the Bombay Veterinary Service, Class II, have been transferred to the Government of Sind, with effect from 1st April 1936.

Name of officer	Post held
Indian Veterinary Service	
MR. J. H. G. JERROM, M.R.C.V.S., I.V.S.	Superintendent, Civil Veterinary Department, Sind and Rajputana.
Bombay Veterinary Service, Class II	
MR. C. S. G. HAJI.	Officer in charge, Goat Virus Producing Station, Karachi.

United Provinces

KHAN BAHADUR MAULVI ABDUL QAYUM, Deputy Director of Agriculture, Western Circle, United Provinces, has been granted leave on average pay for 4 months followed by leave on half average pay for 10 months and 13 days with effect from 3rd May 1937 to 15th July 1938, preparatory to retirement.

MR. VISHNU SHARMA, B.Sc. (Wales), State Tube-well Agricultural Development Officer, Meerut, has been appointed to peform the duties of the Deputy Director of Agriculture, Western Circle, Aligarh, in addition to his own as a temporary measure with effect from 3rd May 1937, *vice* KHAN BAHADUR MAULVI ABDUL QAYUM.

MR. R. D. FORDHAM, officiating Deputy Director of Gardens, United Provinces, will continue as such after 15th January 1937, *vice* MR. W. HEAD, retired.

Punjab

KHAN BAHADUR MAULVI FATEH-UD-DIN, M.B.E., B.A., M.R.A.S., A.R.H.S., I.A.S., resumed charge of his appointment as Deputy Director of Agriculture, Jullundur, on the 31st July 1937, relieving MR. H. G. SADIK, B.A., who reverted to his substantive appointment of Extra Assistant Director of Agriculture.

Central Provinces and Berar

MR. E. A. H. CHURCHILL, B.Sc. (Edin.), of the Indian Agricultural Service, has been granted leave on half average pay for one month commencing from the 11th October 1937 in extension of the leave already granted to him.

RAI BAHADUR R. V. PILLAI, G.B.V.C., Post Graduate R.V.C. (Edin.), has been reposted as Deputy Director of Veterinary Services, Central Provinces and Berar.

On relief by RAI BAHADUR R. V. PILLAI, G.B.V.C., Post Graduate R.V.C. (Edin.), MR. P. S. NAIR, G.B.V.C., officiating Deputy Director of Veterinary Services, Central Provinces and Berar, has reverted to his substantive appointment as Assistant Director of Veterinary Services, Nagpur, and will hold charge of the office of the Extra Assistant Director of Animal Husbandry, in addition to his own duties.

Burma

U Thet Su, D.I.C., B.Ag., B.A.S., Class I, has, on return from leave, been reposted as Mycologist, Burma, with headquarters at Mandalay in place of Mr. D. Rhind, B.Sc., B.A.S., Class I, who will remain as Principal, Agricultural College and Economic Botanist, Burma, with headquarters at Mandalay.

U Tun Yee, Burma Agricultural Service, Class II, Assistant Director of Agriculture, West Central Circle, Magwe, has been transferred to Mandalay and appointed to hold charge of the duties of Deputy Director of Agriculture, Northern Circle, in place of Mr. W. M. Clarke, M.B.E., proceeding on leave.

List of Agricultural Publications in India from 1st February to 31st July 1937

Title	Author	Where published
GENERAL AGRICULTURE		
Agriculture and Livestock in India, Vol. VII, parts, 2 to 4. Annual subscription Rs. 6 or 9*s* 9*d*. (A bi-monthly journal of agriculture and animal husbandry for the general reader interested in agriculture or livestock in India or the Tropics)	Issued under the authority of the Imperial Council of Agricultural Research	Manager of Publications Delhi.
The Madras Agricultural Journal. Monthly. Annual subscription Rs. 4	Published by the M. A. S. Union, Agricultural Research Institute, Coimbatore	The Secretary, M. A. S. Union, Agricultural College, Lawley Road, P. O.
The Journal of the Trichinopoly District Agricultural Association. (English and Tamil). Quarterly. Annual subscription Re. 1-8-0 for non-members, free for members	Issued by the Trichinopoly District Agricultural Association, Teppakulam Post	The Secretary, The Trichinopoly District Agricultural Association, Teppakulam Post.
The Journal of the Mysore Agricultural and Experimental Union. Quarterly. Price As. 12 per copy	V. K. Badami (Chief Editor).	The Secretary, The Mysore Agricultural and Experimental Union, Seshadri Road, Bangalore.
Mysore Vyavasaya Shodhaka Sanghada Patrike (Kannada). Monthly. Annual subscription Rs. 3. Single copy As. 4	N. Venkatsubbaya (Chief Editor)	Ditto.
The Poona Agricultural College Magazine. Quarterly. Annual subscription Rs. 2-8-0.	V. G. Deshpande and S. M. Rao (Editors).	The Editor, *Poona Agricultural College Magazine*, Poona.
Shetki and Shetkari (Marathi). Monthly. Annual subscription Re. 1-8-0.	Vasudev Ganesh Pande	The Editor, *Shetki and Shetkari*, Agricultural College, Poona.

Title	Author	Where published
GENERAL AGRICULTURE—*contd.*		
The Planters' Journal and Agriculturist. Fortnightly. Annual subscription Rs. 10 or 16*s.*	Theo H. Thorne (Editor)	The Manager, *The Planters' Journal and Agriculturist*, 13 Ezra Mansions, Calcutta.
Krishi-Sampada (Bengali). Monthly. Annual subscription Rs. 3.	N. K. Ghosh (Editor) .	The Manager, *Krishi Sampada* Office, Dacca.
Mufid-ul-Mazarain (Urdu) .	Issued by the Department of Agriculture, United Provinces.	Government Printing, and Stationery, United Provinces, Allahabad.
Kisan Upkarak (Hindi) . .	Ditto . .	Ditto.
The Allahabad Farmer. Bi-monthly. Annual subscription in India Rs. 2.	B. M. Pugh (Editor). Published by the Agricultural Institute, Allahabad.	The Allahabad Agricultural Institute, United Provinces (American Presbyterian Mission), Allahabad.
Seasonal Notes. Price As. 4 per copy.	Issued by the Department of Agriculture, Punjab.	Government Printing Punjab, Lahore.
Kisan (Hindi). Quarterly. Annual subscription Rs. 2. As. 8 per copy.	Issued by the Agricultural Association, Bihar.	B. N. Sarkar, Senior Marketing Officer and Editor, *Kisan*, Patna.
The Nagpur Agricultural College Magazine. Quarterly. Annual subscription Rs. 3.	Published by P. D. Nair, Agricultural College, Nagpur.	The Editor, *The Nagpur Agricultural College Magazine*, College of Agriculture, Nagpur.
Annual Report of the Imperial Council of Agricultural Research, 1936-37. Price Re. 1.	Issued by the Imperial Council of Agricultural Research.	Manager of Publications Delhi.
Annual Report of the Indian Central Cotton Committee, Bombay, for the year ending 31st August 1936. Price Rs. 2.	Issued by the Secretary, Indian Central Cotton Committee.	Indian Central Cotton Committee, Bombay.
A Guide to Indian Cottons. Price As. 6.	Ditto. . .	Ditto.

GENERAL AGRICULTURE—*contd.*

Title	Author	Where published
Indian Central Cotton Committee—Its Objects, Activities and Achievements (Tamil and Telugu). Pamphlet (Gratis).	Issued by the Publicity Officer, Indian Central Cotton Committee.	Indan Central Cotton Committee, Bombay.
Summary Proceedings of the 33rd Half-yearly Meeting of the Indian Central Cotton Committee. Price Re. 1.	Ditto . .	Ditto.
Some Notes for the Use of State Agricultural Officers in Central India and Rajputana.	T. R. Low . . .	Director, Institute of Plant Industry, Indore.
Tamil Songs on Agriculture (Tamil). Leaflet No. 75 of the Department of Agriculture, Madras.	Issued by the Department of Agriculture, Madras.	Government Press, Madras.
Coconut Cultivation. (Telugu, Kanarese and Malayalam). Pamphlet No. 8 of the Department of Agriculture, Madras. Free.	J. S. Patel . . .	Ditto .
The Earth Scoop. Leaflet No. 78 of the Department of Agriculture, Madras.	N. G. Charley . .	Ditto.
Improved Turmeric Polisher. Leaflet No. 80 of the Department of Agriculture, Madras.	Ditto . .	Ditto.
Note on Nilgiri Agriculture. Pamphlet No. 10 of the Department of Agriculture, Madras. Free.	D. G. Munro . .	Ditto.
Some Practical Hints on Bee-keeping. Bulletin No. 37 of the Department of Agriculture, Madras. Reprinted.	S. Ramachandran .	Ditto.
Villagers' Calendar for 1937-38 (Tamil, Telugu and Kanarese). Price Anna 1.	Issued by the Department of Agriculture, Madras.	Ditto.

Title	Author	Where published
GENERAL AGRICULTURE—*contd.*		
Annual Report of the Department of Agriculture, Bombay Presidency, for the year 1935-36. Price As. 10.	Issued by the Department of Agriculture, Bombay Presidency.	Government Central Press, Bombay.
Report on the Administration of the Department of Agriculture, United Provinces, for the year ending 30th June, 1936. Price As. 5.	Issued by the Department of Agriculture, United Provinces.	Superintendent, Printing and Stationery, United Provinces, Allahabad.
Hints for the Cultivation of Roses. Bulletin No. 69 of the Department of Agriculture (revised edition of Bulletin No. 36). Price As. 2.	R. D. Fordham . .	Ditto.
Vegetable growing in the Plains of the United Provinces. Bulletin No. 70 of the Department of Agriculture. Price As. 4.	W. S. Smith . .	Ditto.
General Information about Sugarcane Crop in United Provinces. Leaflet No. 37 of the Department of Agriculture. Free.	Issued by the Department of Agriculture, United Provinces.	Ditto.
Improved Methods of Cultivation and other Important Cultural Operations of Sugarcane. Leaflet No. 38 of the Department of Agriculture. Free.	Ditto .	Ditto.
Irrigation of Sugarcane Crop. Leaflet No. 39 of the Department of Agriculture. Free.	Ditto .	Ditto.
Manuring of Sugarcane Crop in United Provinces. Leaflet No. 40 of the Department of Agriculture. Free.	Ditto .	Ditto.
The Utilisation of Molasses as a Manure for Sugarcane. Leaflet No. 41 of the Department of Agriculture. Free.	Ditto .	Ditto.

Title	Author	Where published
GENERAL AGRICULTURE—*contd.*		
Ratooning of Sugarcane (English and Hindi). Leaflet No. 42 of the Department of Agriculture. Free.	Issued by the Department of Agriculture, United Provinces.	Superintendent, Printing and Stationery, United Provinces, Allahabad.
The Elephant or Napier Grass (Urdu and Hindi). Leaflet No. 45 of the Department of Agriculture. Free.	Ditto .	Ditto.
The Berseem Grass (Urdu). Leaflet No. 46 of the Department of Agriculture. Free.	Ditto .	Ditto.
Linseed Cultivation in United Provinces and its Importance in Indian Industries and Trade (Urdu). Leaflet No. 55 of the Department of Agriculture. Free.	Ditto .	Ditto.
Improved *Jowar* Varieties and their Importance in United Provinces (Urdu). Leaflet No. 56 of the Department of Agriculture. Free.	Ditto .	Ditto.
Sunn Hemp Cultivation in United Provinces and its Importance in the Indian Industries and Trade (Urdu). Leaflet No. 57 of the Department of Agriculture. Free.	Ditto .	Ditto.
Sanai ki Karht aur San banane ki kuchh Karamad Batain (Urdu). Leaflet No. 60 of the Department of Agriculture. Free.	Ditto .	Ditto.
Guide to Varieties of Cotton for 1937. Leaflet No. 135 of the Department of Agriculture, Punjab. Free.	Issued by the Department of Agriculture, Punjab.	Government Printing Punjab, Lahore.

GENERAL AGRICULTURE—*contd.*

Title	Author	Where published
A Short Summary of Important Results arrived at or indicated by the Field Experiments conducted by the Research Officers and Deputy Directors of Agriculture at the Central Research Institute, Lyallpur and the Agricultural Stations in the Punjab, during 1936. Free.	Issued by the Department of Agriculture, Punjab.	Government Printing Punjab, Lahore.
Report on the Operations of the Department of Agriculture, Punjab, for the year ending 30th June 1936. Price As. 8.	Ditto . .	Ditto.
A Note on Power Pumping Installation for Irrigation Purposes. Bulletin No. 1 of 1937 of the Department of Agriculture, Bihar. Free.	Issued by the Department of Agriculture, Bihar.	Government Press, Bihar, Gulzarbagh.
Annual Reports on Experimental Farms, Nagpur, Akola, Adhartal, Chhindwara, Powarkhera and Raipur, for the year ending the 31st March 1936. Price Re. 1-8.	Issued by the Department of Agriculture, Central Provinces and Berar.	Government Printing, Central Provinces, and Berar Nagpur.
Improved Varieties of Crops recommended by the Agriculture Department for Chattisgarh (English and Hindi). Leaflet No. 11 of 1937 of the Department of Agriculture, Central Provinces and Berar.	Ditto . .	Ditto.
Cultivation of Onions (English, Hindi and Marathi) Leaflet No. 12 of 1937 of the Department of Agriculture, Central Provinces and Berar.	Ditto . .	Ditto.
Annual Report of the Department of Agriculture, Assam, for 1935-36.	Issued by the Department of Agriculture, Assam.	Government Press, Assam, Shillong.

Title	Author	Where published

GENERAL AGRICULTURE—*contd.*

Title	Author	Where published
A Short Note on Research Work on Paddy in Orissa. Bulletin No. 6 of the Department of Agriculture, Orissa.	Issued by the Director of Development, Orissa.	Orissa Government Press, Cuttack.
Rahar. Bulletin No. 3 of the Department of Agriculture, Orissa.	Ditto . .	Ditto.
Mysore Agricultural Calendar for 1937 (English and Kannada), Price: English As. 2. Kannada Anna 1.	Issued by the Department of Agriculture, Mysore.	Director of Agriculture, Mysore, Bangalore.
Annual Report of the Coffee Scientific Officer, Mysore, 1936-37. Mysore Coffee Experiment Station Bulletin No. 16. Price As. 4.	W. W. Mayne . .	Ditto.
Soya Bean (Malayalam) . .	T. C. Kochunni Pillai .	Government Press, Travancore, Trivandrum.
Iron Plough (Tamil) . . .	P. Padmanabha Iyer .	Ditto.
Tomato Cultivation . . .	M. Madhavan . .	Ditto.
A Kind of Furnace for the Preparation of Arecanut for Chewing Purposes (Malayalam). (Leaflet).	Issued by the Department of Agriculture, Cochin, Trichur.	Cochin Government Press, Ernaculam.
Bee-keeping in the State (Malayalam). (Bulletin). .	Ditto . .	Ditto.
Annual Administration Report of the Department of Agriculture, Hyderabad, for 1344 F. (6th June 1934 to 5th June 1935). Price Rs. 2.	Issued by the Director of Agriculture, Hyderabad, Deccan.	Agricultural Directorate, Hyderabad, Deccan.
Report on the Experimental and Research Work for 1343 F. Price Rs. 2.	Ditto . .	Ditto.

Title	Author	Where published
GENERAL AGRICULTURE—*concld.*		
Annual Administration Reports of the Tea and Coffee Scientific Officers of the United Planters' Association of Southern India for the year 1936-37.	United Planters' Association of Southern India, Coonoor.	United Planters' Association of Southern India, Glenview, Coonoor, Nilgiris.
AGRICULTURAL STATISTICS		
Report on the Accuracy of the All-India Cotton Forecasts of 1934-35 and 1935-36 Season. Statistical Leaflet No. 5 of the Indian Central Cotton Committee. First Issue (1934-36). Price As. 2.	Issued by the Secretary, Indian Central Cotton Committee, Bombay.	Indian Central Cotton Committee, Bombay.
Report on the Staple Length of Indian Cotton Crop of 1936-37 Season. Statistical Leaflet No. 1 of the Indian Central Cotton Committee. Fourth Issue (1936-37). Price Anna 1.	Ditto . .	Ditto.
Season and Crop Report of the Bombay Presidency, for the year 1935-36. Price As. 6.	Issued by the Department of Agriculture, Bombay Presidency.	Government Central Press, Bombay.
Season and Crop Report of Bengal for 1936-37. Price As. 4.	Issued by the Director of Agriculture, Bengal.	Bengal Government Press, Alipore, Calcutta.
Quinquennial Report on the Crop Cutting Experiments of Bengal for the years 1932-33 to 1936-37. Price As. 4.	Ditto . .	Ditto.
Agricultural Statistics, Bihar, 1935-36. Price Rs. 2.	Issued by the Department of Agriculture, Bihar.	Government Press, Bihar, Gulzarbagh.
SUGAR RESEARCH		
Open Pan Boiling for Gur and Sugar Manufacture. Leaflet No. 43 of the Department of Agriculture, United Provinces. Free.	Issued by the Department of Agriculture, United Provinces.	Superintendent, Printing and Stationery, United Provinces, Allahabad.

SUGAR RESEARCH—*contd.*

Title	Author	Where published
How to Distinguish Co. 331 from Co. 213 (with a Diagram). Free.	Issued by the Department of Agriculture, Bihar.	Government Press, Bihar, Gulzarbagh.
Instructions for Sampling of Cane at the Farm. Leaflet No. 3 of 1937 of the Department of Agriculture, Bihar.	Ditto . .	Ditto.
Sugarcane Cultivation (Malayalam)	Issued by the Department of Agriculture, Cochin, Trichur.	Cochin Government Press, Ernaculam.

COTTON TECHNOLOGY

Title	Author	Where published
Further Tests on Indian Cottons with Different Systems of High Draft Spinning. Technological Bulletin No. 37. Price Re. 1.	R. P. Richardson and Nazir Ahmad.	Indian Central Cotton Committee, Bombay.
The Effect of Twist on the Strength and Length of Cotton Fibre. Technological Bulletin No. 22. Price As. 8.	Harirao Navkal and Nazir Ahmad.	Ditto.
Spinning Test Report (No. 808) on Samples of Berar Cotton, 1936-37. Technological Circular No. 276. Price As. 4.	Director, Technological Laboratory, Indian Central Cotton Committee, Bombay.	Ditto.
Spinning Test Report (No. 809) on Samples of C. P. No. 1 Cotton, 1936-37. Technological Circular No. 277. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 810) on Samples of Khandesh Cotton, 1936-37. Technological Circular No. 278. Price As. 4.	Ditto . .	Ditto.
Technological Report on Late Verum (Nagpur), 1936-37. Technological Circular No. 279. Price. As. 4.	Ditto . .	Ditto.

Title	Author	Where published
COTTON TECHNOLOGY—*contd.*		
Technological Report on Punjab-American 189 F., 1936-37. Technological Circular No. 280. Price As. 4.	Director, Technological Laboratory, Indian Central Cotton Committee, Bombay.	Indian Central Cotton Committee Bombay.
Spinning Test Report (No. 812) on Samples of Farm-Westerns Cotton, 1936-37. Technological Circular No. 281. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 813) on Samples of Broach Cotton, 1936-37. Technological Circular No. 282. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 819) on Samples of Surat Cotton, 1936-37. Technological Circular No. 283. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 820) on Samples of Jagadia Cotton, 1936-37. Technological Circular No. 284. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 821) on Samples of Broach/Cotton, 1936-37. Technological Circular No. 285. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 825) on Samples of Muttia Cotton, 1936-37. Technological Circular No. 286. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 826) on Samples of Nanded Cotton, 1936-37. Technological Circular No. 287. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 827) on Samples of Bailhongal Cotton, 1936-37, Technological Circular No. 288. Price As. 4.	Ditto . .	Ditto.

COTTON TECHNOLOGY—*contd.*

Title	Author	Where published
Spinning Test Report (No. 828) on Samples of Navsari Cotton, 1936-37. Technological Circular No. 289. Price As. 4.	Director, Technological Laboratory, Indian Central Cotton Committee, Bombay.	Indian Central Cotton Committee, Bombay.
Spinning Test Report (No. 829) on Samples of Punjab-American Cotton, 1936-37. Technological Circular No. 290. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 830) on Samples of Hubli Kumpta Cotton, 1936-37. Technological Circular No. 291. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 834) on Samples of Surat Cotton, 1936-37. Technological Circular No. 292. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 835) on Samples of Kampala Cotton, 1936-37. Technological Circular No. 293. Price As. 4.	Ditto . .	Ditto.
Technological Report on Sind Sudhar (289F), 1936-37. Technological Circular No. 294. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 837) on Samples of Kadi Viramgam Cotton, 1936-37. Technological Circular, No. 295. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 838) on Samples of Jinja Cotton, 1936-37. Technological Circular No. 296. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 840) on Samples of African Busoga, 1936-37. Technological Circular No. 297. Price As. 4.	Ditto . .	Ditto.

COTTON TECHNOLOGY—*contd.*

Title	Author	Where published
Spinning Test Report (No. 845) on Samples of Jagadia Cotton, 1936-37. Technological Circular No. 298. Price As. 4.	Director, Technological Laboratory, Indian Central Cotton Committee, Bombay.	Indian Central Cotton Committee, Bombay.
Technological Reports on Surat 1027 A. L. F., 1936-37. Technological Circular No. 299. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 846) on Samples of Kadi Cotton, 1936-37. Technological Circular No. 300. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 847) on Samples of Bavla Cotton, 1936-37. Technological Circular No. 301. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 848) on Samples of Westerns Cotton, 1936-37. Technological Circular No. 302. Price As. 4.	Ditto . .	Ditto.
Technological Report on Cambodia Co. 2 (Cambodia 440), 1936-37. Technological Circular No. 303. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 850) on Samples of Bijapur Cotton, 1936-37. Technological Circular No. 304. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 851) on Samples of Farm Westerns Cotton, 1936-37. Technological Circular No. 305. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 852) on Samples of Bagalkote Cotton, 1936-37. Technological CircularNo. 306. Price As. 4.	Ditto . .	Ditto.

COTTON TECHNOLOGY—*contd.*

Title	Author	Where published
Spinning Test Report (No. 854) on Samples of Upland Cotton, 1936-37. Technological Circular No. 307. Price As. 4.	Director, Technological Laboratory, Indian Central Cotton Committee, Bombay.	Indian Central Cotton Committee, Bombay.
Spinning Test Report (No. 859) on Samples of A. R. Busoga Cotton, 1936-37. Technological Circular No. 308. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 860) on Samples of A. R. Kampala Cotton, 1936-37. Technological Circular No. 309. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 862) on Samples of Westerns Cotton, 1936-37. Technological Circular No. 310. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 863) on Samples of Northern Cambodia Cotton, 1936-37. Technological Circular No. 311. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 864) on Samples of Navsari Cotton, 1936-37. Technological Circular No. 312. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 865) on Samples of Tiruppur Cambodia Cotton, 1936-37. Technological Circular No. 313. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 866) on Samples of Miraj Cotton, 1936-37. Technological Circular No. 314. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 869) on Samples of Dholleras Cotton, 1936-37. Technological Circular No. 315. Price As. 4.	Ditto . .	Ditto.

Title	Author	Where published
COTTON TECHNOLOGY—*concld.*		
Spinning Test Report (No. 871) on Samples of Kumpta Cotton, 1936-37. Technological Circular No. 316. Price As. 4.	Director, Technological Laboratory, Indian Central Cotton Committee, Bombay.	Indian Central Cotton Committee, Bombay.
Spinning Test Report (No. 872) on Samples of Karunganni Cotton, 1936-37. Technological Circular No. 317. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 873) on Samples of Kalagin Cotton, 1936-37. Technological Circular No. 318. Price As. 4.	Ditto . .	Ditto.
pinning Test Report (No. 874) on Samples of Tinnevelly Cotton, 1936-37. Technological Circular No. 319. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 875) on Samples of Cambodia Cotton, 1936-37. Technological Circular No. 320. Price As. 4.	Ditto . .	Ditto.
Spinning Test Report (No. 876) on Samples of A. R. Jinja Cotton, 1936-37. Technological Circular No. 321. Price As. 4.	Ditto . .	Ditto.
FRUITS		
Preparation of Guava Jelly (Urdu and Hindi). Leaflet No. 61 of the Department of Agriculture, U. P. Free.	Issued by the Department of Agriculture, United Provinces.	Superintendent, Printing and Stationery, United Provinces, Allahabad.
Pruning of Deciduous Fruit Trees. Bulletin No. 18 of the Department of Agriculture, U. P. Price As. 2-6.	R. S. Singh . .	Ditto.
Cultivation of Figs (Urdu). Leaflet No. 6 of the Department of Agriculture, Hyderabad.	Issued by the Department of Agriculture, Hyderabad.	Deputy Director of Agriculture and Horticulturist, Hyderabad.

Title	Author	Where published
FRUITS—*contd.*		
Cultivation of Oranges. Leaflet No. 7 of the Department of Agriculture, Hyderabad. Free.	Issued by the Department of Agriculture, Hyderabad.	Deputy Director of Agriculture and Horticulturist, Hyderabad.
Cultivation of Mangoes. Leaflet No. 8 of the Department of Agriculture, Hyderabad. Free.	Ditto . .	Ditto.
LAC		
Annual Report of the Indian Lac Research Institute for the year 1935-36.	Issued by the Indian Lac Research Institute, Namkum, Ranchi.	Director, Indian Lac Research Institute Namkum, Ranchi.
Annual Report of the Indian Lac Research Institute for the year 1936-37, May 1937.	Ditto . .	Ditto.
Estimation of Orpiment in Shellac. Bulletin No. 26. Price As. 2.	M. Rangaswami and H. K. Sen.	Ditto.
Some Information and Advice to Shellac Manufacturers, 1937.	Issued by the Indian Lac Research Institute, Namkum, Ranchi.	Ditto.
Some Analytical Data for Pure Shellacs, 1937.	Ditto . .	Ditto
AGRICULTURAL SCIENCE		
GENERAL		
The Indian Journal of Agricultural Science, Vol. VII, parts 1 to 3. Annual subscription Rs. 15 or 24*s*. (Original scientific work in the various branches of science applied to agriculture, formerly published in the Memoirs of the Imperial Department of Agriculture in India is now published in the *Indian Journal of Agricultural Science.*)	Issued under the Authority of the Imperial Council of Agricultural Research.	Manager of Publications, Delhi.
Scientific Reports of the Imperial Agricultural Research Institute, New Delhi, for the year 1935-36 including the Report of the Sugarcane Expert.	Issued by the Director, Imperial Agricultural Research Institute, New Delhi.	Ditto.

AGRICULTURAL SCIENCE—*contd.*

BOTANY

Title	Author	Where published
The Distribution of Gossypium and the Evolution of the Commercial Cottons. Paper No. 7 of the Indian Central Cotton Committee.	J. B. Hutchinson . .	Director, Institute of Plant Industry, Indore.

CHEMISTRY

Title	Author	Where published
The Use of Manures in the Madras Presidency (Tamil and Malayalam). Pamphlet No. 9 of the Department of Agriculture, Madras. Free.	P. Venkataramiah. .	Government Press, Madras.
Preparation of Artificial Farmyard Manure from Surplus Waste Materials from the Fields (English, Hindi and Marathi). Leaflet No. 13 of 1937 of the Department of Agriculture, Central Provinces and Berar. Revised. Price Re. 1-8-0.	Issued by the Department of Agriculture, Central Provinces and Berar.	Government Printing, Central Provinces and Berar, Nagpur.
The Preparation of Starch and Dextrin from Broken Rice. Bulletin No. 33 of the Department of Agriculture, Burma. Price As. 2.	S. P. Aiyar . . .	The Superintendent, Government Printing and Stationery, Burma, Rangoon.
The Preparation of Useful Products from Citrus Fruits. Price As. 2.	Ditto . .	Ditto.
The Preparation of Starch from Broken Rice. Leaflet No. 82 of the Department of Agriculture, Burma. Free.	Ditto . .	Director of Agriculture, Burma, Rangoon.

Title	Author	Where published

AGRICULTURAL SCIENCE—*contd.*

Entomology

Title	Author	Where published
List of Publications on Indian Entomology, 1935. Miscellaneous Bulletin No. 14 of the Imperial Council of Agricultural Research. Price Re. 1-4-0.	Compiled by the Imperial Entomologist, Imperial Agricultural Research Institute, Pusa.	Manager of Publications, Delhi.
The Mango Hopper. Leaflet No. 77 of the Department of Agriculture, Madras.	M. C. Cherian . .	Government Press, Madras.
Insect Pests of Crops. Bulletin No. 5 of the Department of Agriculture, Orissa.	Issued by the Director of Development, Orissa.	Orissa Government Press, Cuttack.
Insect Pests on Mustard and *Mung*. Bulletin No. 4 of the Department of Agriculture, Orissa.	Ditto.	Ditto.
Coffee Stem Borer (*Xylotrechus Quadripes* (Cherr) and Its Control. Circular No. 57 of the Department of Agriculture, Mysore.	Issued by the Department of Agriculture, Mysore.	Director of Agriculture, Mysore, Bangalore.
Contheyla rotunda which attacks Coconut Trees, Plantain Leaves and Arecanut Trees (Malayalam).	Issued by the Department of Agriculture, Cochin.	Cochin Government Press, Ernaculam.

Plant Diseases

Title	Author	Where published
The Leaf Curl Disease of Chillies. Leaflet No. 73 of the Department of Agriculture, Madras (Telugu).	M. C. Cherian . .	Government Press, Madras.
Bud Rot on Coconut Palms in Malabar District. Leaflet No. 74 of the Department of Agriculture, Madras (English and Malayalam).	McRae and F. T. Shaw .	Ditto.
Mahali Disease of Arecanuts in South Kanara (English and Kanarese).	K. T. Alwa . . .	Ditto.

Title	Author	Where published
AGRICULTURAL SCIENCE—*concld.*		
PLANT DISEASES—*contd.*		
Angular Leaf Spot of Cotton. Leaflet No. 138 of the Department of Agriculture, Punjab. Free.	Issued by the Department of Agriculture. Punjab.	Government Printing, Punjab, Lahore.
Factors Affecting Spray Success in the Control of Coffee Leaf Disease (*Hemileia Vastatrix* B and Br). Bulletin No. 15 of the Mysore Coffee Experiment Station.	W. W. Mayne . .	Director of Agriculture, Mysore, Bangalore.
VETERINARY SCIENCE AND ANIMAL HUSBANDRY		
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